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A TREATISE

ON

THE DISEASES

OF

INFANCY AND CHILDHOOD.

BY

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SIXTH EDITION, THOROUGHLY REVISED.

WITH FORTY ILLUSTRATIONS.

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PREFACE TO THE SIXTH EDITION.

In preparing the Sixth Edition, the author has revised the text to such an extent, that a considerable part of the book may be considered new. Such thorough revision was required by the advancement of our knowledge of the diseases of children since the last edition was issued. Some of the important maladies in the book have been entirely rewritten, such as cerebro-spinal fever, scarlet fever, pseudo-membranous croup, and infantile diarrhœa, and the treatment of many of the diseases has been revised. The index has been prepared by J. Lewis Smith, Jr., physician to the Class of Children's Diseases, in the Bureau for the Relief of the Outdoor Poor, Bellevue.

J. L. S.

No. 62 West 56th St., New York,
January 1, 1886.

PREFACE TO THE FIFTH EDITION.

THE constant endeavor of the author, as successive editions of this treatise have been called for, has been to make it more useful to the medical student and to the physician in his daily practice. He has avoided discussion of theories, except as they influence practice, while he has devoted more space to the therapeutics of the various diseases. He has been stimulated to this by constant intercourse with physicians, so as to be able to appreciate their wants, and by letters of inquiry sent by physicians, which, for the most part, relate to matters of treatment.

J. L. S.

No. 227 WEST 49TH ST., NEW YORK,
September 16, 1881.

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THE

DISEASES OF CHILDREN.

PART I.

CHAPTER I.

INFANCY AND CHILDHOOD.

Infancy and childhood are, in certain respects, the most important and interesting periods of life. To the physiologist they are especially interesting, because they are the periods of development and of greatest functional activity; to the pathologist, because in them many diseases occur which are rarely or never observed in the other periods, or which present in these periods peculiar features; to the physician and vital statistician, because in them there are the greatest amount of sickness and largest number of deaths.

Infancy extends from birth to the age of two and a half years, or till the completion of first dentition. In infancy the organs are delicately organized, containing a large proportion of water, and hence are easily injured. In this period the brain is rapidly developed—more so than any other organ; animal matter predominates in the bones; the arteries are relatively large, the muscles small; the superficial veins are small. Fat is absent from the interior of the body, but abundant, in well-nourished infants, underneath the integument. The skin is delicate, and its temperature not much below that of the blood. At birth it has a reddish hue, and is covered with soft, fine hairs (lanugo). The reddish hue gradually fades into the healthy tint of infancy, and the hairs fall out. In the first two months the sweat-glands have little functional activity, sensible perspiration being quite rare. Subsequently perspiration is freer, and in certain diseased states (rachitis, etc.) is abundant. The sebaceous glands in the first half of infancy are active, particularly upon the scalp, producing often a pale yellow incrustation, consisting of sebaceous matter and epidermic cells.

The secretions from the mucous surfaces commence at an early period. At birth the surface of the digestive tube is covered with more or less mucus, often in considerable quantity. The meconium is not considered, as formerly, to be a product of intestinal secretion. It consists of flat

epithelial cells, fine hairs, oil-globules, crystals of cholesterin, and brownish or yellowish masses of coloring matter probably from the liver. It is supposed that, with the exception of the coloring matter, the meconium is derived mainly from the amniotic fluid which the fœtus has swallowed.

The most wonderful change occurring in the system at birth, through the exigencies of the new life, is that in the circulation. The flow of blood being interrupted, thrombi form in the umbilical vein and arteries, and in the ductus arteriosus and ductus venosus, and these vessels gradually atrophy, becoming finally shrivelled but permanent cords. I have many times at autopsies removed the plug from the ductus arteriosus when death had occurred as late as the third week. The foramen ovale closes slowly. I have ordinarily found it open till near the end of the first half year, but the valve covers fully the aperture, so that there is no detriment to the circulation. Both the pulse and respiration are more frequent during infancy than childhood, and are more accelerated by moral and physical causes.

The stomach has a smaller relative size and emesis is more readily caused than in the adult. The liver is large, occupying at birth nearly half of the abdominal cavity, but it grows smaller in successive months. The appetite is good and digestion active, so that hunger, when appeased, soon returns. The thymus gland, at birth about the size of an expanded lung, slowly atrophies, but it does not totally disappear till after infancy.

The kidneys, distinctly lobulated at birth, gradually change their form, so as to present in the last part of infancy nearly the shape of the organ in the adult. The renal secretion commences early, even before birth. The kidneys seldom undergo degenerative changes as in the adult, but they are liable to congestions and inflammations. During the first month, and especially the first fortnight, crystals of uric acid, and the urates, are often found in the urine, in a state of apparent health, causing more or less fretfulness in their elimination, staining the diaper, and not infrequently being arrested in the tubules of the pyramids, where they can be seen as pink-colored spots or lines (uric acid infarction). These deposits of uric acid and the urates may even occur in the fœtus, producing obstruction and inflammation of the renal tubes. Congenital cystic degeneration of the kidneys is, in the opinion of Virchow, due to them. In early infancy the senses are imperfectly developed, the eyes being attracted only by bright objects, and the sense of hearing affected only by loud noises. Sleep is the normal state in the first weeks of life; as the age of the infant increases, less and less sleep is required; but the oldest *infants* need more than children, and several hours more than adults.

The new-born infant is apparently destitute of mental faculties. It seeks the breast by instinct, and it exhibits no perception or reflection. The loud cries with which it commences its existence are not from anger or suffering; they appear to be normal, like the act of nursing, and providentially designed, in order to expand the lungs. It is not till the close, or near the close, of the first month, that the gray substance of the brain begins to appear—the probable seat of the mind,

and the source of all mental phenomena. Perception and curiosity are early manifested. The infant, as Edmund Burke has remarked, is constantly seeking new objects for its amusement, rejecting old playthings for such as possess more novelty. Reflection, a higher faculty of the mind, appears at a later period. The mind and the bodily organs in infancy are, in a high degree, impressionable. Anger is excited by trivial causes, but is easily appeased; and the various functions in the system are disturbed by agencies which in youth or manhood would have no appreciable effect.

CHILDHOOD extends from infancy to the age of fifteen years or puberty. It is a period of great physical activity, and of rapid growth. The functions of the various organs are performed with more moderation than in infancy, and are less frequently deranged. The volume of the brain continues to increase rapidly, and it becomes firmer than in infancy. It is estimated that by the seventh year the weight of this organ has doubled. The mind now exerts a controlling influence over the actions of the individual. The digestive organs have changed, so that solid food is required. Most of the glandular organs are less active than in the greater part of infancy, and some of them, as the liver, are relatively smaller. The pulse and respiration gradually become less frequent as the child advances in age.

CHAPTER II.

CARE OF THE MOTHER IN PREGNANCY.

THE frequency of miscarriages and still-births, and the large number of ill-formed and puny infants, born to a precarious and short existence, render imperative, on the part of the mother, a strict observance of the laws of health, and an avoidance of all exciting or perturbating influences during the time when the fœtus is being developed. The diet should be plain and easily digested, but nutritious. There is often a craving in pregnancy for unusual articles of food. These may sometimes be allowed within certain limits, provided that they are such as do not derange the stomach. Meats and animal broths, together with vegetables and farinaceous food, should constitute the ordinary diet, and should be taken at regular intervals.

Daily exercise, never violent, but moderate and gentle, is requisite. No exercise is better, none safer and more likely to contribute to cheerfulness and healthy functional activity of the organs, than the ordinary household duties. Lifting heavy weights, or work which, like washing and ironing, causes great and continued action of the abdominal muscles, should be avoided. Such exercise is highly injurious, and is apt to

produce premature labor. Exercise in the open air, on foot, or by an easy conveyance, conduces to the health of the mother and the growth and development of the fœtus. On the other hand, rapid riding over rough roads is one of the most dangerous modes of exercise. It has been known to destroy the fœtus, which up to that time had been apparently vigorous. When such a result occurs, there is probably more or less detachment of the placenta.

It being a matter of the utmost importance that the health of the mother should continue good during gestation, any disease which she may have in this period, and which affects her nutrition or the character of her blood, should be promptly cured if practicable, and with the least possible reduction of the vital powers. Intermittent fever, occurring during gestation, should never be allowed to continue. It seriously retards fœtal development, and may produce miscarriage. Unless it be controlled by proper measures, the offspring, though born at term, is puny and emaciated. Syphilis, in the pregnant woman, also requires treatment. This disease, readily transmitted from the mother to the fœtus through the ovum or the uterine circulation, may be eradicated by anti-syphilitic treatment of the mother, or at least so modified that the infant is born vigorous and healthy.

The pregnant woman should avoid all causes of undue mental excitement. This is almost as necessary as the avoidance of great physical exertion. There is, during pregnancy, unusual susceptibility to mental impressions, and this should be borne in mind not only by the woman herself, but by those who associate with her.

Strong emotions, whether of joy, sorrow, or anger, affect primarily the nervous system, but indirectly most of the organs of the body. Observations have long established the fact that such emotions influence the state and functions not only of the digestive and glandular, but muscular organs, as the heart and uterus. Physicians are familiar with cases in which vivid mental impressions produced uterine contractions, and even miscarriage, or have disturbed the catamenial function. Therefore, the associations and cares of pregnant women should be such as conduce to cheerfulness and equanimity.

It is the popular belief, and the belief of many physicians, that vivid mental impressions sometimes have a direct effect on the development of the fœtus. Many cases are on record in which infants were born with marks or deformities corresponding in character with objects which had been seen and had made a strong impression on the maternal mind at some period of gestation. Whether the mind of the mother exert a controlling influence on the form and color of the fœtus, is a subject of great interest to the psychologist as well as the physiologist and physician, since it involves no less a question than the power and scope of the human mind. Violent emotions, it is admitted, may affect directly most of the important organs in the system. They may derange the liver, causing jaundice, accelerate, or for a moment suspend, the heart's action, stimulate the kidneys, causing diuresis, or even the intestinal follicles, causing watery evacuations. But with all these organs the brain is connected by nerves which anatomy reveals. On the other hand, the mother and fœtus have a distinct existence as regards their

nervous systems, and even their blood. Still, the multitude of facts which have accumulated justify the belief that deformity, or other abnormal development of the fœtus is, at times, due to the emotions of the mother. Some of the cases related by Dr. Whitehead, in his work on hereditary diseases, are very striking and difficult to explain on the ground of coincidence. I have met the following cases. An Irish woman of strong emotions and superstitions was passing along a street in the first months of her gestation, when she was accosted by a beggar, who raised her hand, destitute of thumb and fingers, and in "God's name" asked for alms. The woman passed on; but reflecting in whose name money was asked, felt that she had committed a great sin in refusing assistance. She returned to the place where she had met the beggar, and on different days, but never afterward saw her. Harassed by the thought of her imaginary sin, so that for weeks, according to her statement, she was made wretched by it, she approached her confinement. A female infant was born, otherwise perfect, but lacking the fingers and thumb of one hand. The deformed limb was on the same side, and it seemed to the mother to resemble precisely that of the beggar. In another case which I met, a very similar malformation was attributed by the mother of the child to an accident occurring to a near relative, which necessitated amputation during the time of her gestation. I examined both of these children with defective limbs, and have no doubt of the truthfulness of the parents. In May, 1868, I removed a supernumerary thumb from an infant, whose mother, a baker's wife, gave me the following history: No one of the family, and no ancestor, to her knowledge, presented this deformity. In the early months of her gestation she sold bread from the counter, and nearly every day a child with double thumb came in for a penny roll, presenting the penny between the thumb and the finger. After the third month she left the bakery, but the malformation was so impressed upon her mind that she was not surprised to see it reproduced in her infant.

Professor William A. Hammond, of this city, in an interesting paper on the "Influence of the Maternal Mind," etc. (*Quarterly Journal of Psychological Medicine*, January, 1868), says: "The chances of these instances, and others which I have mentioned, being due to coincidence, are infinitesimally small, and though I am careful not to reason upon the principle of POST HOC, ERGO PROPTER HOC, I cannot, nor do I think any other person can, no matter how logical may be his mind, reason fairly against the connection of cause and effect in such cases. The correctness of the facts can only be questioned; if these be accepted, the probabilities are thousands of millions to one that the relation between the phenomena is direct." Professor Dalton also says (*Human Physiology*): "There is now little room for doubt that various deformities and deficiencies of the fœtus, conformably to the popular belief, do really originate in certain cases from nervous impressions, such as disgust, fear, or anger, experienced by the mother." The observations on which this belief is based relate both to man and the lower animals. A very strong argument in its support is, as Professor Hammond remarks, the popular opinion, which dates back to the time of Jacob. (Genesis xxx.) An almost universal sentiment, running through centu-

ries, is rarely wholly fallacious. It has some truth for its foundation, especially when, as in this instance, the subject is one of observation.

If maternal emotions affect the development of the exterior of the fœtus, as observations show, and physiologists admit, the presumption is strong that they may affect also the proper development and adjustment of the parts of the brain, an organ so complex and delicate, and may therefore give rise to idiocy. Dr. Seguin (*Idiocy and its Treatment*, etc., New York, 1866) thus remarks on this point: "Impressions will, sometimes, reach the fœtus in its recess, cut off its legs or arms, or inflict large flesh wounds, before birth, . . . from which we surmise that idiocy holds unknown though certain relations to maternal impressions, as modifications to placental nutrition."

It is an interesting fact that abnormalities of structure, occurring from whatever cause, are apt to be propagated to descendants. Dr. Carpenter and others relate instances among the lower animals, and similar instances of transmission have now and then been observed in the human race. Thus, in the issue of *Nature* for March 7, 1878, it is stated on the authority of M. Lenglen, a physician of Arras, that a certain M. Gamelon in the last century had two thumbs on each hand, and two great toes on each foot; this peculiarity did not appear in the son, but it reappeared in the three succeeding generations, so that some of the great-great-grandchildren possessed it in as marked a degree as their ancestors.

FIG. 1.

In view of such important facts, the duty of the pregnant woman is rendered the more imperative to avoid the presence of disagreeable and unsightly objects, as well as all causes of excitement, and to remove, as soon as possible, vivid and unpleasant impressions, by quiet diversion of the mind.

The disastrous results upon the fœtus of severe injuries received by the mother are well known to the profession, for premature labor and death of the child, or feebleness from its prematurity, are common results of such accidents. In rare instances the child may be so injured as to be deformed for life, as in the following interesting case: Richard L., aged six years, came, in January, 1877, to the children's class in the Bureau for the Relief of the Out-door Poor. The following history was obtained: On November 27, 1870, one month before the birth of Richard, the mother fell heavily on the ice when stepping from a city car. Uterine hemorrhage resulted, which continued more or less freely, producing marked pallor,

till her confinement, which occurred December 23d. The position of the child *in utero* was crosswise, but nothing untoward occurred in the delivery. Immediately after its birth, when it was being washed by the nurse, a blister, about one inch in diameter, was observed on the right side of the thorax, located about one inch below and two and a half inches externally to the nipple. A cicatrix resulted which now marks the site of the sore. When the blister healed the child seemed entirely well, and nothing more was thought of the unusual occurrence of an intrauterine vesication, till nearly half a year had elapsed, when the thorax below the nipple and at the site of the cicatrix, was observed to be depressed, and the depression has continued to the extent indicated in the woodcut.

The ribs at the point of depression are found to be widely separated; the rib below being pushed downward so as to form one side of the triangle, its cartilage the second side, and the rib above the hypothenuse. The distance of the perpendicular line passing from the costo-chondral articulation of the lower rib to the upper rib, or the hypothenuse, is two and a half inches by measurement. The depression in this triangular space evidently resulted gradually from the wide separation of the ribs, and the consequent loss of resiliency in the thoracic walls in the space destitute of bony support. The child lay crosswise *in utero*, and it seems probable that the injury was produced by the pressure of its arm against the ribs during the fall. Cases like the above, and the graver cases in which fœtal life is sacrificed, or the child is born to a puny and uncertain existence from prematurity, show the very great importance of a quiet and regular life on the part of one who is about to become a mother; for bodily injuries, like unpleasant sights, occur when least expected.

CHAPTER III.

MORTALITY OF EARLY LIFE: ITS CAUSES AND PREVENTION.

No fact is better known in the profession than that the first years of life constitute the period of greatest mortality.

In England, where there is an accurate registration of births and deaths, statistics show fifteen deaths in every hundred infants in the first year of life, and between four and five deaths in the first month. Statistics on the continent correspond with those in England, as regards the periods of greatest mortality. Quételet says: . . . . "There die during the first month after birth, four times as many children as during the second month after birth, and almost as many during the entirety of the two years that follow the first year, although even then the mortality is high. The tables of mortality prove, in fact, that one-tenth of children born die before the first month has been completed."

In this country, in consequence of deficient registration of births, the percentage of deaths to births cannot be accurately ascertained. In this city, 53 per cent. of the total number of deaths occur under the age of five years, and 26 per cent. under the age of one year. According to the census of 1865, there were in New York City 95,020 children under the age of five years, and during the five years ending with 1865, 49,000 children five years old and under had died. Therefore, according to these statistics, more than one-third of all the infants born in this city die under the age of five years. An error, however, occurs from the fact that, while the death statistics were complete, it is known there were more children in the city than were embraced in the census returns. Still it may, I think, be safely stated that one-fourth of the children born in this city die before the age of five years.

In less crowded cities and the rural districts, it is known that the percentage of deaths in the first years of life to the total number of deaths is considerably less than in New York City, but it is nevertheless large.

As the child advances toward puberty, the liability to sickness and death gradually diminishes, but even the last years of childhood present a considerably larger percentage of deaths to the population than does youth or manhood.

The causes of this great mortality of infants and children, and the means of diminishing it, deserve careful consideration.

Some of the causes which conspire to produce it are to a considerable extent unavoidable. Such are congenital vices of formation of internal organs. Many of the internal malformations necessarily occasion an early death. Cases of anencephalus, most cases of congenital hydrocephalus, of spina bifida, of cyanosis, are fatal before the close of infancy. These defects of formation we cannot detect before birth, and their causes are often obscure. Some of them seem to result from inflammation, believed to be, occasionally, syphilitic, developed at some period of fœtal existence. Other internal malformations are attributable to perturbating influences, operating temporarily on the mother during gestation. But in a large proportion of cases, we cannot assign the cause. Obviously, only partial success can attend our efforts, as regards prevention, in these cases, and almost no success, as regards the use of remedial measures.

Another obvious cause of the great mortality of early life, is natural feebleness of system, especially in infancy. The younger the patient, prior to the middle period of life, the sooner are the vital powers exhausted by disease. Hence a larger proportion of infants succumb to the same malady, than children, and a larger proportion of children than adults. This statement is true of infancy and childhood in general. It is a law in nature, and cannot be changed by art. But there are many infants born with hereditary disease, or a strong predisposition to disease, through a fault, which is, in a degree, curable, in the system of one or both parents; as, for example, the syphilitic, scrofulous, or tubercular diathesis. Parents seriously affected by such diseases cannot, without corrective treatment, have healthy offspring. Their children are among the first to droop and die, either directly from the inherited

disease, or from feebleness of constitution which such disease entails, and which renders them an easy prey to other diseases. The duty of the physician, as regards such parents, is obvious. He may, by therapeutic and hygienic measures, secure a more healthy progeny, and, so far as he can do this, he aids in diminishing the infantile mortality. He may sometimes, by timely measures directed to the infant, establish a better state of health.

The subject of hereditary disease is one of great interest and importance, especially as regards the city population. Inherited affections are less common in the country, but in the city they contribute largely to the number of deaths in early life.

Another important cause of the great mortality of children, is the fact that they are peculiarly liable to certain severe and fatal maladies. I allude particularly to the acute infectious diseases, which, as a rule, occur but once, and that in childhood. Some of them, as scarlet fever, greatly increase the number of deaths. They extend and become epidemic through the intercourse of children. We are constantly witnessing in New York the spread of the acute contagious diseases, especially of whooping-cough, measles, scarlet fever, and diphtheria, through the schools. Measures employed, thus far, by boards of health, or other local authorities, to prevent the dissemination of these and kindred diseases, have been but partially successful except in regard to smallpox. In the large public schools especially, these maladies are most frequently contracted, and from them they radiate over the school districts; for if, as is now common, at least in New York City, a child comes to school wearing clothes which at home have lain in a room where a brother or sister was sick with measles or scarlet fever; or if he enter the class with a mild pertussis or diphtheria, certain of his classmates will probably return home infected with the virus of the disease. The same remarks are applicable, though with less force, to private schools. From both such schools, I have over and over again witnessed the dissemination not only of the maladies mentioned, but also of the milder infectious diseases, as mumps and varicella. The Health Board of New York City have recently, by stringent enactments regulating the schools, accomplished much in suppressing this source of the infectious diseases.

In hospitals and asylums for children, much can be done to prevent the occurrence of the infectious diseases by strict surveillance and prompt isolation of all suspicious cases. Without such care, scarcely a year passes in which these institutions are not scourged by one or more of these diseases. Much has been said of the crowding of families in tenement-houses, so common in New York and other large cities, by which a large number of children are brought under one roof; of the uncleanliness of person and apartment to which it leads, and of the insufficient air and space which it allows to each. But one of the strongest objections, in my opinion, to the present plan of building and crowding tenement-houses is the facility which it affords for the spread of the contagious diseases of childhood; and it is in such houses, as shown by statistics, that these maladies are the most frequent and fatal. The much-needed enactments or regulations in relation to the construction

and occupancy of such houses, would, among other salutary effects, greatly diminish the death-rate from the infectious maladies.

Over the most loathsome, and formerly the most fatal, malady of mankind, namely, smallpox, we now have, or can have, complete control by statutory enactments enforcing vaccination. It is only by carelessness or the lack of sufficiently stringent regulations relating to the matter that smallpox is not "stamped out." Again, some of the most fatal inflammatory diseases of life occur chiefly in childhood, as croup and capillary bronchitis. These and kindred diseases can only be prevented by proper hygienic management on the part of families, and the circulation of tracts, or other means calculated to educate families in reference to the management of children, cannot fail to diminish the number of cases of such inflammations, and, consequently, of the deaths from them.

Another obvious and important cause of the mortality of early life, is the antihygienic condition or state in which many children live, in consequence of the poverty or gross negligence of parents.

Residence in insalubrious localities, personal and domiciliary uncleanliness, exposure without proper protection to vicissitudes of weather, are fertile causes of sickness and death. Hence one reason for the great infantile mortality among the city poor, who live in damp and dark alleys, and in crowded and filthy tenement-houses, breathing night and day an atmosphere loaded with noxious gases. All physicians are aware how the most fatal diseases, such as Asiatic cholera, cholera infantum, diphtheria, and typhus fever, seek the quarters of the city poor, and what terrible havoc they make there. All are aware, also, what wonderful recoveries result, when feeble and attenuated infants, gradually sinking with chronic diseases, induced in great measure by the foul air, are transferred from such localities to the pure air of the country.

Careless management of young children as regards dress increases greatly the liability to local diseases, such as commonly occur from exposure to cold. These are inflammatory affections, seated chiefly upon the mucous surfaces, but sometimes in parenchymatous organs. Adults, aware of the effect of sudden change of temperature from warm to cold, or of exposure to currents of air, protect themselves by additional clothing. Such precautionary measures are often lacking in the management of young children, and hence one cause of their great liability to local affections, both of the respiratory and digestive organs.

Routh, in his excellent treatise on *Infant Feeding*, says: "Among the most pernicious influences to young children, however, we may include cold; the change of temperature from 45° to 4° or 5° below zero, as before stated, producing an increase of mortality in London alone of three to five hundred. As out of one hundred deaths, however, from all specified causes, nearly twenty-four occur to children under one, and thirty-six to children under five, the great increase of mortality to children by cold is thus at once made obvious. Indeed, it is a household word among us, which takes its origin from the Registrar-General's returns, that a very cold week always increases the mortality of the very young and the very aged."

Lastly, a very important cause of mortality in early life is the use of

improper food. In infants, artificial feeding in place of the aliment which nature has provided for them, and, in children, the use of innutritious or indigestible articles of diet, give rise to diarrhœal maladies, emaciation, and death in numerous instances. Sometimes, also, defective alimentation is the cause of scrofulous or tuberculous ailments, and sometimes it gives rise to a cachexia or feebleness of system, which, without engendering any positive disease, renders those thus affected less able to support disease induced by other causes. A committee, of which Professor Austin Flint, Jr., was chairman, appointed in 1867 to revise the "dietary table of the Children's Nurseries on Randall's Island," states, with much truth and force: "Children . . . are not capable of resisting bad alimentation, either as regards quantity, quality, or variety. At that age the demands of the system for nourishment are in excess of the waste; the extra quantity being required for growth and development. If the proper quantity and variety of food be not provided, full development cannot take place, and the children grow up, if they survive, into puny men and women, incapable of the ordinary amount of labor, and liable to diseases of various kinds."

Improper feeding, like other causes of mortality, is much more injurious, much more frequently the cause of death, in the city than in the country. Statistics in Europe, as well as this side of the Atlantic, establish this fact. It is in infancy, and especially in the first year, that the use of unwholesome food entails the most serious consequences. No artificially prepared food is a good substitute for the mother's milk, and hence artificial feeding of the infant, unless under the most favorable circumstances, results disastrously. In the country, where salubrious air and sunlight conspire to invigorate the system, where a robust constitution is inherited, and where cow's milk, fresh and of the best quality, is readily obtained, lactation is not so necessary for the well-being of the infant; but in the city, its importance cannot be too strongly urged.

The foundlings of cities afford the most striking and convincing proof of the advantages of lactation. In some cities foundlings are wet-nursed, while in others they are dry-nursed, and the result is always greatly in favor of the former. Thus, on the Continent, in Lyons and Parthenay, where foundlings are wet-nursed almost from the time that they are received, the deaths are 33.7 and 35 per cent. On the other hand, in Paris, Rheims, and Aix, where the foundlings were wholly dry-nursed, at the date of the statistics their deaths were 50.3, 63.9, and 80 per cent.

In this city the foundlings, amounting to several hundred a year, were formerly dry-nursed; and, incredible as it may appear, their mortality with this mode of alimentation, nearly reached 100 per cent. Now wet-nurses are employed for a portion of the foundlings, with a much more favorable result.

These facts, to which others might be added from the experience of European cities, show the importance of lactation as a means of reducing infantile mortality in the cities. What has been stated as regards the result of artificial feeding of foundlings, is true, in great measure, in reference to all city infants. The ill-effect of artificial feeding is well

known in this city, and it is the common practice in families to employ a hired wet-nurse, if, for any reason, the mother's milk is insufficient.

When the infant has reached the age at which it is proper to wean, the digestive organs are less frequently deranged by errors of diet. More substantial food, and considerable variety in it, may now be not only safely allowed, but are required by the wants of the system. In infancy, therefore, the mortality is largely increased by improper diet, while in childhood the diet is a much less common cause of death.

CHAPTER IV.

WEIGHT, GROWTH, LACTATION.

Dr. K. Parker, Resident Physician of the New York Infant Asylum, weighed, immediately after birth, 170 infants—89 male and 81 female—born consecutively, and at term, with the following result:

Average male weight	7 lbs. 11 oz.
" female "	7 " 4 "

Fifty of these, who were wet-nursed, and apparently well taken care of, were weighed when one week old, with the following result:

Increase of weight in	32 cases.
Loss of weight in	13 "
Average gain	$4\frac{8}{10}$ oz.
" loss	$3\frac{1}{3}$ "
Greatest gain	12 "
" loss	6 "

AVERAGE GAIN.

From birth to age of 4 months (25 cases)	4 lbs. $8\frac{3}{4}$ oz.
" 3 to 6 months (6 cases)	3 " $3\frac{1}{6}$ "
" 6 to 9 " "	2 " $7\frac{1}{8}$ "
" 9 to 12 " "	1 " $15\frac{1}{2}$ "

It is desirable that the infant, as soon as it requires nutriment, should receive breast-milk. If it be fed for a few days with the bottle or spoon, it may be difficult finally to induce it to take the breast; therefore it is well to determine early whether the mother will be able to wet-nurse her infant, so that, if unable, suitable provision may be made.

The matter of determining beforehand the capability of the mother for wet-nursing has been investigated by Dr. Donné, of Paris, and in his treatise on *Mothers and Infants*, he describes the mode in which it may be ascertained. The desired information, in his opinion, may be acquired by examining the colostrum, which is secreted in small quan-

tity, in the last months of gestation, and which can be squeezed from the breast in sufficient quantity for inspection.

In some women, according to Dr. Donné, the colostrum is so scanty that only a drop, or half a drop, can be obtained from the nipple by careful pressure. This will be found by the microscope to contain but few milk-globules, ill-formed, and a few granular bodies, such as the colostrum ordinarily contains. Such women almost invariably furnish poor milk, and in small quantity. In other women the colostrum is abundant but thin, resembling gum-water; it lacks the yellow streaks and viscous character of ordinary colostrum, and it flows readily from the nipple. The milk of such women is sometimes scanty, sometimes abundant, but it is watery and deficient in nutritive principles. In a third class of women the colostrum is pretty abundant, and it contains yellowish streaks, of more or less consistence, which are found to be rich in milk-globules of good size. Women furnishing such colostrum in the last weeks of gestation will have sufficient milk and of good quality. These latter women make the best wet-nurses.

Hindrances to Lactation and Physical Conditions Rendering it Improper.

The primipara often experiences difficulty in wet-nursing in consequence of a depressed state of the nipple. It is not sufficiently prominent to be readily grasped by the mouth, and after ineffectual attempts, the infant becomes fretful when applied to the breast, and perhaps for a time refuses it altogether. Multiparæ occasionally experience the same inconvenience, but it is not common when there has once been successful lactation. By calmness and perseverance on the part of the mother, the nursling can usually be made to seize the nipple in the course of a week.

Depression of the nipple is, to a certain extent, the result of pressure upon it by the dress during gestation. The state of the nipples should, indeed, in those who have never suckled, receive early attention, even before the birth of the infant. Tightness of dress around the breast, as also upon every part of the body, should be avoided, and from time to time gentle traction should be made upon the nipple, if it be depressed. It may be drawn out by the fingers of the mother several times each day, or by a common breast-pump, or by suction with a tobacco pipe, the edge of the bowl having been smoothed. Occasionally, in these cases of depressed nipple, the mother, fatigued and discouraged by her frequent ineffectual attempts to induce the infant to nurse, becomes feverish and excited, so that the quantity of her milk is sensibly diminished. The physician should assure her, as he usually can with confidence, that in a few days, as the baby becomes a little stronger, there will be no difficulty in its nursing. Some women are unremitting in their endeavors to procure nursing. This should be forbidden, since the lack of sleep, and the nervousness which such constant endeavor produces, tend to defeat the object which they have in view, by diminishing the secretion of milk. Sufficient sleep, freedom from anxiety,

and no more frequent application of the infant to the breast than is required in successful lactation should be enjoined. Occasionally we can best succeed in procuring lactation under these circumstances of discouragement by the aid of another infant, older, more vigorous, and better able to seize the nipple. An exchange of infants for a few times may remedy the difficulty.

Occasionally suckling is rendered difficult and painful by too long delay before applying the infant to the breast. When the mother has rested a few hours after her confinement, about six in ordinary cases, lactation may commence. There is, at first, but very little milk, often only a few drops, but the secretion is promoted by nursing, so that the requisite amount is sooner obtained than when the infant is kept from the breast till the second or third day. If, as some physicians advise, suckling be deferred till the breasts are full and tender, and if, as is often the case with primiparæ, the nipples are also tender, many mothers lack the fortitude required to allow their infants to obtain a sufficient amount of milk. Excoriated and fissured nipples constitute a serious impediment to lactation. They are very sensitive on pressure, and are long in healing. They are fully described in works which relate to female diseases, and their treatment pointed out. Occasionally fissured nipples do harm to the infant by the blood which escapes and is swallowed with the milk. A case is related in which positive indigestion was caused in this way; the infant vomiting, after each nursing, milk mixed with blood. The local hindrances to lactation described above can, in most instances, be relieved in the course of a few weeks. To what extent menstruation and pregnancy are detrimental to the nursing, and, therefore, contraindicate lactation, will be considered in another section.

There is, occasionally, a constitutional state of the mother which necessitates either the employment of a hired wet-nurse or weaning. This is the case when there is a strong tendency to tuberculosis. If the complexion be pallid, the system at all emaciated, and suckling be attended by more or less exhaustion, and if with fair trial of wine and tonics no improvement follow, the physician is justified in forbidding further attempts at wet-nursing. If, under such circumstances, an hereditary tendency to tuberculosis exist, it is his duty positively to interdict nursing. The opinion of the physician, in such a matter, should be formed after mature deliberation. There are many women who, suffering temporarily from illness, and discouraged, are ready at once to abandon their infants to the care of others, with the least encouragement on the part of the physician to do so, but who, by attention to their own health, and especially by taking more sleep, soon recover from their depression, and become good wet-nurses. On the other hand, night-sweats, a cough, and progressive decline in health, show the need of immediate suspension of wet-nursing.

Sometimes women, prior to pregnancy, present indubitable evidence of tuberculosis, but by the improved general health which attends pregnancy, the disease is temporarily arrested. Such women should never suckle their infants. If they do, they soon lose all that was gained, and the disease advances rapidly. These objections to wet-nursing in

such a state of health apply to the mother. There are also objections as regards the infant. The milk of those in decidedly infirm health is deficient in nutritive principles. Their infants, therefore, are ill-nourished, and, if they have inherited a predisposition to tuberculosis, there is great danger that this disease will be developed in them; whereas, with healthy wet-nursing, even a strong predisposition may remain latent. M. Donné relates the following instructive cases, which show the danger which sometimes attends suckling, and the imperative necessity which may arise of discontinuing it. "A very light-complexioned young mother, in very good health, and of a good constitution, though somewhat delicate, was nursing for the third time, and, as regarded the child, successfully. All at once this young woman experienced a feeling of exhaustion. Her skin became constantly hot; there were cough, oppression, night-sweats; her strength visibly declined, and in less than a fortnight she presented the ordinary symptoms of consumption. The nursing was immediately abandoned, and from the moment the secretion of milk had ceased, all the troubles disappeared." "A woman of forty years of age . . . having lost, one after another, several children, all of whom she had put out to nurse, determined to nurse the last one herself. . . . This woman, being vigorous and well built, was eager for the work, and, filled with devotion and spirit, she gave herself up to the nursing of her child with a sort of fury. At nine months she still nursed him from fifteen to twenty times a day. Having become extremely emaciated, she fell all at once into a state of weakness, from which nothing could raise her, and two days after the poor woman died of exhaustion."

A very similar case recently occurred in my practice. A young and healthy woman from the country, suckling her second infant, on coming to the city lived in a dark and very imperfectly ventilated room on the first floor, and in the rear of a crowded tenement-house. She soon lost her appetite, but continued suckling for three months, when she became so anæmic and feeble that she was compelled to seek medical advice. She died without local disease, notwithstanding the most nutritious diet and free use of stimulants and tonics.

Constitutional syphilis in the mother does not contraindicate lactation. It is probable that the infant also has it. The mother should take anti-syphilitic remedies, which will eradicate the disease in herself, and also, if it be present, in the infant. Febrile affections, also, do not in general contraindicate lactation. They may, however, for a time, diminish the quantity of milk or impair its quality. If, however, the mother be in a critical state, or much reduced, whatever the disease, suckling should cease. Whether or not the infant should be taken from the breast, if the mother be suffering from one of the essential fevers, depends on the severity of the malady, and the degree of her exhaustion. Twice I have known newly born infants to be suckled by mothers, while the latter had scarlet fever, without contracting it, but suffering immediately afterward from protracted and severe eczema. In the country, where artificially fed infants, as a rule, do well, it might be best to wean if the mother be affected with such a disease, but in the city eczema is less dangerous than the diarrhœal affections which early

weaning is apt to entail. In most cases of typhus and typhoid fevers, weaning or procuring a wet-nurse is necessary, on account of the depression of the vital powers which these diseases produce.

Inflammatory affections, unless of a dangerous character, do not ordinarily interfere with lactation, except that the quantity of milk is somewhat diminished. In severe inflammation, it may be so necessary to husband the strength, or to keep the patient perfectly quiet, that suckling her infant would be injudicious. It should then be transferred to a wet-nurse or weaned. Inflammation of the breast often presents an impediment to lactation. It is a common and painful affection, suspending or greatly diminishing the secretion of milk in the affected gland. Nursing should cease as soon as there are evident signs of inflammation, unless it be limited to a small part of the gland. General heat of the breast, with tenderness and induration extending over a considerable part of it, indicates the need of the immediate removal of the infant from it. Lactation must be restricted to the unaffected side. It is often the case that the volume of the inflamed gland is considerably increased from the afflux of blood to it, and from the interstitial exudation, while it contains little or no milk, and attempts at lactation, under such circumstances, are injurious to the mother as well as to the infant. The cause of the swelling should be explained to the mother, who commonly attributes it to the accumulation of milk, and worries herself and the infant by attempts to make it nurse. As the inflammation abates, by resolution, or more commonly by suppuration, and the normal secretion returns, the first milk, which is apt to be thick and stringy, should be rejected, after which the infant may nurse as usual. Occasionally, the abscess which has formed in the breast connects with a lactiferous tube, so that pus may, on suction, escape from the nipple. If this occur, of course lactation should be interdicted until pure milk is obtained. Pus in the milk can sometimes be detected by the naked eye. It presents a yellowish or greenish color, occurring in streaks when not intimately mixed with the milk. When it is intimately mixed, and in small quantity, it cannot be detected by the naked eye, but the microscope reveals the pus-globules. M. Donné relates a case in which he discovered these globules by the microscope, although there were at first no other evidences of an abscess, and doubts were expressed in reference to the accuracy of his observation. Finally, an abscess pointed and discharged.

Sometimes, when the inflammation abates, the secretion does not return, and, worse still, occasionally the inflammation has occurred so near the nipple that the lactiferous tubes are permanently closed by it, so that, though milk form in the breast, there is no escape for it. Thenceforth lactation must be entirely from one breast.

If erysipelas occur in the mother, the infant should be immediately taken from her breast and from her arms. If this disease should not be communicated to the infant through the milk, or through fissures in the nipple, of which there is danger, still the milk is apt to undergo such change in consequence of the erysipelas as to endanger the health of the child. Thus, one of the wet-nurses in the New York Infant Asylum sickened with severe facial erysipelas on the 24th of April,

1875, eight days after the death of her baby. She was wet-nursing a foundling, aged seven weeks, at the time of the commencement of the erysipelas, and as it was very important that her milk should be preserved for the coming hot months, it was deemed best to allow the nursing to continue, the infant being placed in a crib at a little distance as soon as it dropped the nipple. On the 27th, the baby was troubled with diarrhœa. April 28th, its morning temperature was 101°, and that of the evening 103°, the diarrhœa continuing. It was now removed entirely from the breast, and was given artificial food. On the 29th there was a decided general icteric hue of the infant's surface, which continued till its death on May 1st. The stools numbered about eight daily till April 30th, when they ceased. The record which I preserved does not state whether there was vomiting, but it had probably been slight on account of the speedy prostration. Death occurred from exhaustion. At the autopsy, from half an ounce to one ounce of pus was found in the peritoneal cavity, newly formed fibrin was observed upon the spleen and liver, and the peritoneum generally had lost much of its lustre; a careful microscopic examination of the liver and its ducts, made by Dr. Heitzmann, revealed no anatomical change which would explain the icteric hue, and it seemed probable that this was due to the altered state of the blood. The mucous membrane of the intestines exhibited vascular streaks, and its follicles were distinct. The lesions, therefore, indicated intestinal catarrh. Nothing unusual was observed in the heart and lungs of the infant. Its life had apparently been sacrificed by the unhealthy nursing.

Colostrum.

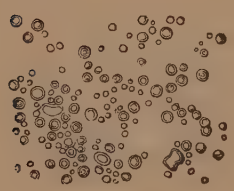
The milk secreted during gestation, and immediately after the birth of the infant, differs in its gross appearance, as well as chemical and microscopical characters, from that which is ordinarily secreted during lactation. It is termed Colostrum. It has a turbid and yellowish appearance, and is somewhat viscid. It is decidedly alkaline, and undergoes lactic acid fermentation more readily than common milk, and it also contains more solid matter. It has an excess of fat, of salts, and, according to Simon, also of sugar. It appears, from Simon's analysis, that the solid matter of colostrum is about 17 per cent., while that of the ordinary breast-milk is about 11 per cent.

Examined by the microscope, the colostrum is seen to contain oil-globules and a viscid substance, which often assumes an ovoid or globular form, but which also exists in irregular masses of considerable size. This substance has been thought by some to be mucus, but it is dissolved by acetic acid and potash, and is tinged yellow by a watery solution of iodide. It is therefore to be regarded as albuminous. Embedded in this substance are oil-globules, which are for the most part of small size, while the free oil-globules of colostrum are larger than those occurring in healthy milk. This viscid substance, with the imprisoned oil-globules, constitutes what has been designated the "colostrum-corpuscles." Some have erroneously considered the "colostrum-corpuscles"

to be compound granular cells. The compound granular cell, or corpuscle, is a cell which has undergone fatty degeneration. It is distended with oil-globules to perhaps twice or thrice its normal size. On the other hand, examination of the "colostrum-corpuscles" fails to detect a cell-wall, and the large and irregular size of some of these corpuscles negatives the idea that they are cells. The oil-globules contained in the viscid substance are more readily acted on by ether than are the free oil-globules.

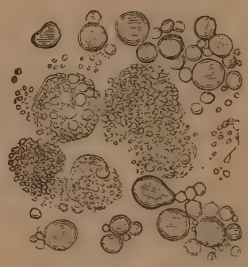
The colostrum is replaced by milk of the normal character in six to eight days; sometimes as early as the third or fourth day after delivery.

Fig. 2.



Milk-globules.

Fig. 3.



Colostrum-corpuscles.

In exceptional instances the colostrum does not disappear for several weeks, and it may reappear at any time during lactation, as a consequence of derangement of the system, or from disease. It is assimilated with difficulty by the digestive organs of the infant, producing usually a laxative effect. It, therefore, aids in the removal of the meconium, and, being a normal secretion in the first week of lactation, it is to be regarded as beneficial. Continuing longer than the first week, its effect is deleterious. It produces evident derangement of the digestive organs, and the infant that habitually nurses it never thrives. It has diarrhœa or vomiting, becomes more or less emaciated, and suffers from colicky pains. Sometimes an extreme degree of exhaustion is reached before the cause is suspected, for, if the milk be pretty abundant, the admixture of colostrum with it cannot be detected by the naked eye. The microscope alone reveals it. The following is an interesting example of this fact. In 1868, an infant six weeks old was brought to me, with the following history: The mother had for several years been troubled with dyspeptic symptoms, but had otherwise been in good health. The infant at birth was fleshy and strong, but after the first week it had never thrived like other infants. It nursed regularly, and the quantity of milk was apparently sufficient, but it vomited as soon as it ceased nursing; it was much emaciated, and the bowels were habitually constipated. The digestive organs of the infant had been in this unhealthy state, with little variation, from the first week, and it was very evident, from the emaciation and exhaustion, that it must soon perish unless some change were effected. The milk of the mother presented the usual appearance to the naked eye, but under the microscope colostrum-corpuscles were observed. A wet-nurse was immediately

obtained, and from that moment the gastrointestinal symptoms disappeared, with a rapid recovery. This case shows at once the evil effects of the colostrum, and the need of a microscopic examination of the milk whenever the nursling suffers from lactation.

Human Milk.

The specific gravity of human milk is about 1032. It has been carefully analyzed by different chemists, with nearly the same result. The following table, prepared by MM. Vernois and Becquerel, gives the proportion of the various ingredients in 1000 parts:

Water	889.08
Sugar	43.64
Casein and extractive	39.24
Butter	26.66
Salts (ash)	1.38
	1000.00

Recently Prof. Albert R. Leeds has analyzed forty-three samples of healthy human milk, with the following results:

	Average.	Minimum.	Maximum.
Specific gravity	1.0317	1.030	1.0353
Water	86.766	83.34	89.09
Total solids	13.234	10.91	16.66
Total solids not fat	9 221	6.57	12.09
Fat	4.013	2.11	6.89
Milk-sugar	6.997	5.40	7.92
Albuminoids	2.058	0.85	4.86
Ash	0.21	0.13	0.35

It is seen that the constituents of healthy human milk vary considerably in different women, especially the albuminoids, which are the nutritive part. Leeds found all the samples alkaline except one, which was neutral. The heat-producing constituents, the carbohydrates, fat, and sugar vary less than the albuminoids. Although human milk seems thinner than cow's milk, it nevertheless contains more solids and less water, and has a greater specific gravity. Milk sugar is its largest solid constituent. Both the sugar and the fat are in greater proportion than in cow's milk, while the amount of albuminoids is much less. A very important difference between woman's milk and cow's milk is in the casein, not only in the quality, but quantity. The casein of cow's milk coagulates in large, firm masses, digested with difficulty by the infant, and its quantity is nearly five times greater than that in human milk, as we see by the following analysis of Prof. Leeds. Leeds found the average specific gravity of cow's milk 1029.

	Woman's Milk.			*Cow's Milk.*		
	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.
Water	87.09	83.69	90 90	87.41	80.32	91.50
Total solids	12 91	9.10	16.31	12.59	8.50	19 68
Fat	3.90	1.71	7.60	3.66	1.15	7 09
Milk-sugar	6.04	4.11	7.80	4.92	3.20	5.67
Casein	0.63	0.18	1.90	3 01	1.17	7.40
Albumen	1.31	0.39	2.35	0.75	0.21	5.04
Albuminoids	1.94	0.57	4.25	3.76	1.38	12.44
Ash	0.49	0.14	?	0.70	0.50	0.87

Milk, being the sole food of early infancy, contains all the nutritive principles which are required for the growth and repair of the different tissues. Most of the salts which occur in the tissues exist primarily in the milk. Phosphate of lime, phosphate of magnesium, phosphate of the peroxide of iron, chloride of potassium, and chloride of sodium, known to exist in cow's milk, are believed to occur also in human milk. Epithelial cells are sometimes present, derived from the lining membrane of the lactiferous tubes.

Modification of Milk in Consequence of the Diet.

The relative proportion of the different ingredients of the milk varies according to the diet. If the diet be poor, the amount of water increases, and that of butter and casein diminishes. Lehmann says (*Phys. Chemistry*, vol. ii. p. 65): "From experiments made on bitches, it would appear that a vegetable diet renders the milk richer in butter and sugar; while the solid constituents are augmented when a sufficient quantity of mixed food is given. Peligot found the milk of an ass most rich in casein when the animal had been fed on beet-root; while it was richest in butter when the food had consisted of oats and lucerne. Fat food increases the quantity of the butter. Boussingault found the milk of a cow richer in casein when the animal had been fed on potatoes than when other food was taken. Reiset found that the milk of cows which were at grass was much richer in butter than when the animals had stood all night in their stall without food; but Playfair found, on the contrary, that the quantity of butter in the milk increased during the night as much as during their stall-feeding, but that the quantity of butter in the milk was considerably diminished by the motion of the animals in the fields."[1] Simon made the following analyses of the milk of a poor woman. She was suddenly, during the period of lactation, deprived of the means of support, so that her food was insufficient in quantity, and of poor quality. The amount of her milk was not diminished by privation, but the solid constituents were reduced to 86 parts in 1000. After this, for a time, her diet was nutritious and abundant, the quantity of milk was increased, and the solid constituents amounted to 119 parts in 1000. Her diet was again reduced, with a reduction of the solid elements to 98 in 1000, and, at a later period, the diet was again nutritious, with an increase of the solid elements to 126. The chief variation observed in the milk of this woman was in the amount of butter.

Modification of Milk from its Retention in the Breast.

M. Peligot has clearly demonstrated that the longer milk is retained in the breast the more watery it becomes. This is explained on the supposition that the solid portion is first absorbed. Therefore, the milk is richer the more frequently it is removed from the breast. A

[1] Animal Chem., Sydenham Soc.'s Tran., vol. ii. p. 55.

similar fact, which has the same explanation, has long been known, namely, that the first milk taken from the breast is thinnest, while that which flows last is richest. That first removed has remained longest in the gland, while that which comes last is but recently secreted.

A knowledge of this fact is of considerable practical importance. The milk, as M. Donné has shown, may be too rich, so as to cause indigestion, with more or less enteralgia, in the infant. Some nurslings, if the milk be too rich and abundant, reject a part of it by vomiting, but others do not, and suffer the consequence in derangement of the digestive organs. For such cases the remedy is, to give the breast less frequently, by which a less amount of milk is taken, and milk of a poorer quality. On the other hand, if there be poverty of the milk, and the infant be insufficiently nourished, the milk is more nutritious, if the nursing be at short intervals.

Modification of Milk by Age and by Mental Impressions.

The composition of milk varies, also, according to the age of the infant. Simon analyzed the milk of a woman at intervals for the period of about six months. In this case the amount of casein at first was small, but the quantity increased during the two months succeeding delivery, after which it was nearly stationary. A similar increase was observed in reference to the saline substances. The sugar, on the other hand, diminished in quantity as the infant grew older, its maximum amount being in the first and second months. The quantity of butter in the milk varies from day to day more than the other elements.

Many observations have been published which show that the composition of the milk may be materially changed by mental impressions. The infant has died suddenly in the act of nursing, after his mother had been violently excited. Such a case is related by Tourtnal. The infant ceased nursing, gasped, and died in the mother's lap. In other cases convulsions have occurred. MM. Becquerel and Vernois made the chemical analysis of the milk of a woman in a state of nervous excitement, and found that the solid constituents were diminished to 91 parts in 1000, the most marked diminution being in the butter, which was only about 5 parts. In a case related by Parmentier and Deyeux the milk became watery and viscid, and remained so till the nervous attacks, from which the patient suffered, had ceased. Dairymen are well aware how ill-treatment and the separation of the calf from the cow diminish the milk which she yields. A new milkman seldom obtains as much milk as one with whom the cow is familiar. Bouchut, alluding to the influence of the moral affections on the secretion of milk, makes the following remark, the truth of which most mothers will acknowledge: "It is also a fact, that the sight of the nursling, the idea of seeing it at the breast, and the joy which certain mothers thence experience, exercise a moral influence over the secretion of the milk entirely independent of their will. They feel the draught of milk as soon as they behold their child, or think of it too deeply; and in a woman who saw her child fall to the ground, the flow of milk ceased, and did not reappear until the child, having quite recovered, attempted to take the breast."

Modification of Milk by the Catamenial Function, Pregnancy, and Other Causes.

The catamenia reappear in most women before the close of lactation, often by the fifth or sixth month after delivery. If this function be re-established in the normal manner—that is, without any derangement of the system, without pain or undue profuseness—no unfavorable result ordinarily occurs with the infant. On the other hand, if the mother suffer any disturbance of the system, or if the menses be profuse, the lacteal secretion may be so changed that the infant is injuriously affected by it. The symptoms produced are those of indigestion, such as abdominal pains, more or less vomiting, and diarrhœa. This result is, however, in my experience, quite exceptional. In rare instances, more dangerous symptoms occur in the infant. A case has been reported to me in which, at each catamenial period, the nursling was seized with convulsions.

Charles Marchand found in three chemical analyses of the milk during menstruation, a diminution of two to four parts in the butter, of two to five parts in the sugar, and a diminution in the casein and albumen of two to five parts. This seems but a trifling change when we recollect that human milk in the state of health contains, according to the analysis of M. Robin and others, 25 to 37 parts of butter, 37 to 49 parts of sugar, and 29 to 39 parts of casein, in 1000 of milk. If the menses reappear with regularity, when the infant has attained the age of ten or twelve months, they should be considered as designed to supersede the secretion of milk, which, indeed, usually begins to diminish. Weaning is then proper. If the menses return early in the period of lactation, and give rise to symptoms in the infant in consequence of the altered quality of the milk, it is best to allow but little nursing during the catamenia, and to employ artificial feeding instead, until the flow of blood ceases.

The change produced in the milk by pregnancy is, in general, more injurious to the nursling than that caused by the reappearance of the menses. The milk of the pregnant woman frequently contains more or less of the viscid substance which characterizes colostrum. Still, the milk of pregnancy does not, ordinarily, derange the digestive function as much as colostrum, in the first weeks of lactation, for pregnancy rarely occurs till after the infant is five or six months old, when the organs of digestion are less readily disturbed. The injurious effect of pregnancy on the infant is shown by vomiting or diarrhœa, by restlessness and occasional abdominal pains,—in fine, by symptoms of indigestion. In many cases, however, these symptoms do not occur, and the infant, though nursing regularly, continues to thrive. No doubt, as a rule, the nursling should be weaned when there are clear evidences of pregnancy, but, under certain circumstances, weaning is injudicious. I have, on different occasions, been called to infants, in midsummer, dangerously sick with diarrhœal attacks induced by this cause. These infants were, perhaps, doing well, or suffering but little from indigestion, when the mothers, suspecting themselves pregnant, at once withdrew them from

the breast, and cholera infantum or a kindred disease was the result. No infant in the city should be weaned in the hot months. It is much safer, though there be indubitable signs of pregnancy, that it continue nursing till the cold weather. The better method is, however, under such circumstances, to employ a wet-nurse, or to remove the infant to the country, and wean it there. In cold weather, it is usually safe to wean an infant in the city after it has reached the age of five or six months.

Sometimes a young mother devotes herself unremittingly to the care of her infant, giving it the breast every hour or oftener through the day, and frequently through the night. She gives the infant little rest and has but little herself. This devotion, praiseworthy as it is, is nevertheless very injurious to both parties concerned. The rule should be repeated and remembered, that while an infant may nurse hourly during the first month, except in the hours which the mother requires for sleep, in which it should not nurse more than once or twice, after the first month nursing should be restricted to intervals of two hours till the third or fourth month; and in older infants, with greater capacity of the stomach, to intervals of three or four hours. Too frequent nursing produces indigestion with its usual fretfulness, and diarrhœa, and it deprives the mother of the mental composure and rest which are required for successful lactation, but the more the infant frets, in many instances, the oftener the mother applies it to the breast, which only increases the indigestion. Worriment and lack of sleep tend not only to diminish the milk, but also to impair its quality.

Venereal excesses have a very injurious effect on the character of the milk. In our remarks on the hygienic treatment of the summer diarrhœa of infants, we allude to authenticated cases in which excesses of this kind caused fatal intestinal catarrh in the nurslings. Again, the relative proportion of the ingredients in the milk may habitually vary from the normal without any assignable cause, so as to be injurious to the infant. Habitual ill-health, as from phthisis, anæmia, syphilis, or severe nervous disorder, sometimes so affects the secretion of milk, as to render it unsuitable for the infant. It may cause a reappearance of the colostrum, like that immediately after parturition. Medicinal substances also sometimes occur in the milk, among which may be mentioned the ethereal oils, iron, iodide of potassium, arsenic, zinc, mercury, the salines, bismuth, lead, antimony, rendering it unsuitable for lactation. It is a well-known fact, that the peculiar flavor of certain vegetables, taken as food, may be noticed in the milk. It is admitted, also, that the specific virus of the contagious diseases, at least certain of them, may enter the milk, so as to give rise to the same diseases in the infant.

Differences in Suckling Women as Regards Quantity and Quality of Milk.

There is a great difference, in different women, as regards the quantity and quality of their milk, and even the mode in which it is secreted. The best wet-nurses are usually robust without being cor-

pulent. Their appetite is good, and their breasts are distended from the number and large size of the bloodvessels and milk-ducts. There is but a moderate amount of fat around the gland, and tortuous veins are observed passing over it. Such nurses do not experience a feeling of exhaustion and do not suffer from lactation.

The nutriment which they consume is equally expended in their own sustenance and the supply of milk. There are other good wet-nurses who have the physical conditions which I have described, but whose breasts are small. Still, the infant continues to nurse till it is satisfied, and it thrives. The milk is of good quality, and it appears to be secreted, mainly, during the time of suckling. Other mothers evidently decline in health during the time of lactation. They furnish milk of good quality and in abundance, and their infants thrive, but it is at their own expense. They themselves say, and with truth, that what they eat goes to milk. They become thinner and paler, are perhaps troubled with palpitation, and are easily exhausted. They often find it necessary to wean before the end of the usual period of lactation. There is another class whose health is habitually poor, but who furnish the usual quantity of milk without the exhaustion experienced by the class which I have just described. The milk of these women is of poor quality. It is abundant, but watery. Their infants are pallid, having soft and flabby fibre. All these kinds of wet-nurses are met in practice.

Occasionally, a considerable part of the milk is lost by oozing from the breast. This sometimes occurs in robust women, but is more frequently associated with weakness. It is then due to a relaxed state of the orifices of the milk-ducts. Galactorrhœa, as the excessive secretion and flow of milk are designated, is said to be often associated with a menorrhagic diathesis: that is, women whose menses have been profuse are apt to have too abundant a flow of milk, corresponding with the menorrhagia. It is said that galactorrhœa is also apt to occur in those who are subject to discharges from parts which sustain no immediate relation to the breast, as in cases of hæmorrhoidal flux, diabetes insipidus, etc. Excitement, or irritation of the uterus or ovaries, may serve as an exciting cause of galactorrhœa in those predisposed to it, and excessive suckling may have the same effect.

Scantiness of Milk; its Causes and Treatment.

Though the amount of breast-milk which the infant requires is less than was estimated by Cumming, still insufficiency of this secretion is not uncommon, especially in cities. According to the statistics of Drs. Merei and Whitehead, among healthy mothers there is insufficiency in 16.5 per cent., while among mothers in feeble health the percentage is 46.6. In treating of this subject in the following pages, reference is not had to those cases in which there is temporary diminution of milk from acute disease or other perturbating causes, but to those cases in which there is habitual scantiness.

One cause of scanty secretion of milk is a life of privation or of daily

work, which necessitates separation from the infant. Insufficient food may render the milk more watery, as has already been stated, or it may cause diminution in its quantity. The mother thus situated is pallid. She is subject to palpitation and attacks of faintness. Her condition, indeed, is that of anæmia. Working women have scantiness of milk, not only in consequence of hardships, but also because they are usually separated for hours from their infants. Age is also a cause of scantiness of milk. Mothers at the age of forty years ordinarily furnish less milk than between twenty and thirty. Those who have not borne children till late in life, and whose mammary glands have, therefore, long been inactive, have less milk than those who commence bearing children at the usual period.

Routh speaks of hyperæmia as a cause of defective lactation. "This is a variety," says he, "which I have chiefly observed among hired wet-nurses, selected from the poorer classes, and admitted into wealthier families. . . . When feeding at the expense of a master or mistress, the amount they devour often surpasses all moderate imagination. They, in fact, gormandize. If in such instances a wet-nurse be given all she asks for, she will be found often to eat quite as much as any two men with large appetites; and, as a result, she becomes gross, turgid, often covered with blotches or pimples, and generally too plethoric to fulfil the duties of her position. The plethora, as first induced, is of the sthenic variety, but it soon assumes an asthenic character, and, as the immediate result, the breast no longer secretes its quantum of milk. There may be good milk secreted; but it is in small quantity, and this quantity diminishes daily. The breast may also enlarge, but it is from a deposition of fatty tissue in and about it, as in other parts of the body. The veins on the surface become less apparent, always a bad feature in a suckling breast, till finally the flow of milk ceases altogether."

Atrophy of the breast from the employment of iodine, or from long disuse, is also a cause of insufficiency of milk.

It is so necessary for the health and development of the infant that the milk should be in proper quantity as well as quality, that it is best in a work of this kind to consider the treatment of insufficient secretion, and, on the other hand, of excessive secretion and loss of milk, or galactorrhœa, and first of insufficient or scanty secretion.

The most efficient mode of increasing the lacteal secretion is that which is also natural, namely, suction from the nipple. There are many cases on record in which this has produced the flow of milk in women who have never borne children, and even in men. Baudelocque mentions the case of a girl, eight years old, who suckled her brother for a month, and cases at the opposite extreme of life have been reported; one of a women of seventy years, who wet-nursed a grandchild twenty years after her last confinement.

The following case, which was under my observation, is interesting in this connection: Lizze S. was confined with her first child on May 30, 1876. When the baby was a few days old, and before she had left the bed, she had inflammatory symptoms which proved to be due to pelvic cellulitis. Its course was tedious; her milk diminished, and

its secretion soon ceased. On or about the first of August she began to sit up, and on August 11th she was admitted into the Sixty-first Street branch of the Infant Asylum, pale and wasted, but with returning appetite. She had no mammary secretion for eleven weeks, and her breasts were small and flabby. She had two fistulous openings, one vaginal, and the other low down in the back, near the lower end of the sacrum or the coccyx. The baby was in a fair condition, having been suckled by other women. Experiences in this and other institutions show that infants having breast-milk do far better and are much more likely to live than those without breast-milk, and the mother was therefore advised by one of the managers—himself a physician—to suckle her baby, although there was not a drop of milk in her breast, and nursing had been suspended eleven weeks. To the surprise of the mother, and of the nurses in the house—to whom the procedure seemed very ridiculous—milk began to appear in a few days. The mother left the institution October 8th; but before her departure she was able to furnish, perhaps, two-thirds the quantity of milk which her infant required. This case affords practical illustration of the fact that frequent nursing is the most efficient galactogogue. Mothers sometimes, having little breast-milk, suckle their babies at long intervals, and finally discouraged at the unproductive state of their breasts resort to weaning, when, by patience and more frequent lactation, they might become good wet-nurses. In the cities, and during the summer season, in which breast-milk is so much required, the history of cases like the above, and the more remarkable cases in which men and grandparents have had secretion of milk and have suckled infants, should induce the physician to withhold his consent to permature weaning, which the disheartened mother is apt to suggest, unless indeed he perceive other reasons for weaning apart from scantiness of milk.

Travellers among barbarous nations or tribes have often observed these cases of unnatural lactation. Humboldt saw a man, thirty-two years old, who gave the breast to his child for five months, and Captain Franklin, in the Arctic regions, met a similar case. Dr. Livingstone, in his African travels, says that he has examined several cases in which a grandchild has been suckled by a grandmother, and equally remarkable instances of lactation occur among the negroes of the Southern and Middle States. Professor Hall presented to his class in Baltimore, a male negro, fifty-five years old, who wet-nursed all the children of his mistress. In these cases of abnormal lactation, so far as we have accurate records of them, it is ascertained that the breasts were torpid, and even sometimes, as in old people, atrophied till the nursing commenced. Titillation, or pressing of the nipple, caused an affiux of blood to the gland, and developed its functional activity, so that milk was produced for the sustenance of the nursling. Therefore, in case of scanty secretion of milk, the mother may increase the quantity by applying the infant often to the breast. If, dissatisfied with the small amount of nutriment which it receives, it refuse to make the necessary suction, any other mode of gentle traction or pressure may be employed in addition. The occasional employment of another infant, or a pup, milking the breast with the thumb and fingers, or the gentle suction of

a breast-pump, aids in stimulating the secretion. One of the best breast-pumps kept in the shops is that to which the name "The Mother's Blessing" has been applied. Forcible rubbing or traction of the breast defeats the purpose for which it is employed. It produces too much irritation and tenderness. The best mode of stimulation is by nursing, as it is the natural mode, and the moral effect of the infant at the breast aids in promoting the secretion.

Another mode of increasing the functional activity of the mammary glands is by the electrical current. The fact is established by physiological experiments, that glandular organs can be made to secrete more actively by the stimulus of electricity, and, accordingly, this agent has been sucessfully employed to promote the secretion of milk. In Routh's *Infant Feeding* several cases are related which show the beneficial effects of this agent (page 149 et seq.). Among them are six reported by Dr. Skinner, of Liverpool. In all these, one or two applications of the electrical current sufficed to restore the secretion. The following is Dr. Skinner's mode of employing this treatment:

"1. *Direct.*—Both poles must terminate in cylinders, with sponges well moistened in tepid water. The positive pole is pressed deep into the axilla, while the negative is lightly applied to the nipple and the areola; the current being no stronger than is agreeable to the patient's feelings. The poles are kept in this position for about two minutes.

"2. *Intramammary.*—The poles are to be, as it were, embedded in the mamma, and moved about, raising and depressing both poles at once in and around the organ for the space of another two minutes. The same is to be done to both breasts daily, until the secretion is properly established. Hitherto one or two sittings have always sufficed in my hands." (*Communication of Dr. Skinner to Dr. Routh.*)

In all cases of scanty secretion of milk, the regimen of the mother is a matter of importance. Personal and domiciliary cleanliness is essential for successful wet-nursing. A certain amount of exercise in the open air is conducive to the health of the mother, and to the secretion of abundant and healthy milk. A case is related to show the effect of fresh air and outdoor exercise on the lacteal secretion. A lady of cleanly habits, living in London, had a very scanty supply of milk. She removed to the pure air of the seashore, and immediately the quantity became abundant, and continued so for months. Such cases are not infrequent. A mode of life that contributes to the general health of the mother will not fail to augment the quantity of her milk, if it be scanty, and to improve its quality.

Much has been written in reference to the diet of women who suckle. It is a popular belief that certain articles of food promote the secretion of milk much more than other articles, though equally nutritious. No doubt, writers have erred in recommending exclusively this or that kind of food, as most likely to produce milk. The exact kind of food which is preferable, in a certain case, depends partly on the physique of the individual, and partly on the character of the food to which she has been accustomed. A mixed diet contributes most to the sustenance of the mother, and to an abundant secretion of milk. Animal substances which furnish a due supply of nitrogenous aliment should be

given with the farinaceous. Mothers pallid, and inclining to an anæmic condition, require a larger proportion of animal diet than those in good general health. On the other hand, plethoric women, such as Routh describes, who with excellent appetite consume large quantities of food, and who become more and more full-blooded and corpulent while the milk diminishes, require a more restricted animal diet, in connection with more exercise, especially in the open air.

There are certain kinds of food which do appear to have a galactogogue effect with most wet-nurses. Oatmeal gruel is one of these. Wet-nurses often remark, after taking a bowl of this, that they feel the flow of milk. Cow's milk with some has a similar effect. Porter or ale, taken once or twice a day, also promotes the secretion of milk, especially in those who have poor appetite, and whose systems are somewhat reduced.

A great variety of medicines has been used for their supposed galactogogue effect. Medicines which improve the general health are, no doubt, sometimes useful for this purpose, such as the vegetable and ferruginous tonics and, perhaps, cod-liver oil. But there are other medicines which it is claimed have a specific effect on the mammary gland, promoting its secretion. Lettuce, winter-green, fennel, the broom tops (scoparius), and marsh-mallow, have been used for this purpose. There can be no doubt that the aromatic stimulants, as fennel, anise, and caraway seeds, given in soups, sometimes stimulate the lacteal secretion. Another medicine which has been recommended to the profession, as a galactogogue, is castor oil and the plant from which it is derived.

CHAPTER V.

SELECTION OF A WET-NURSE.

In the cities, cases are frequent in which mothers, with all possible care or endeavor, find themselves unable to suckle their infants. Their health is too poor, or the milk possesses the properties of colostrum, or it is no longer secreted, on account of nervous excitement, or exhaustion, or inflammation of the breasts. The number of such cases in the city would surprise physicians who are familiar only with the healthy and robust mothers of the country. The infant thus deprived of the mother's milk should, if practicable, be furnished with a wet-nurse.

The selection of a wet-nurse often devolves upon the physician, and is a duty of great responsibility. It is better to select one between the ages of twenty and thirty years, and one who has suckled an infant previously. A wet-nurse between the ages of twenty and thirty is

usually more active, cheerful, and conciliatory than one of a more advanced age, and her milk is more apt to be abundant and nutritious. Those who have previously suckled and had charge of infants, are obviously more competent to serve as wet-nurse than are primiparæ. The milk of a wet-nurse whose infant is under the age of six months, will ordinarily agree with a new-born infant. If above that age, it sometimes agrees, but often does not.

The most difficult and responsible task imposed on the physician in the selection of a nurse, is to ascertain the exact condition of her health, and the quantity and quality of her milk. Constitutional syphilis is common in the class of women who present themselves for wet-nursing; it is often latent, or its symptoms are easily concealed, and it is communicable by lactation. The virus may be received by the infant from fissures or excoriations of the nipple. The nursling tainted by syphilis may, on the other hand, communicate the disease to the nurse through the same source. It is not fully ascertained whether the syphilitic virus may be conveyed to the infant by the milk. But the cases which have accumulated in the records of medicine are numerous, in which infants, born of healthy parents, have been fully syphilized by lactation from diseased nurses (see article Syphilis). These infants have sometimes led a short and miserable existence, and have occasionally increased the misery of the household by imparting the disease to others. The duty is, therefore, imperative on the part of the physician to examine carefully the wet-nurse, in reference to any evidences of the syphilitic taint. Acquainted with the symptoms of syphilis, he may usually, by shrewd questioning and by careful examination of the present appearance and condition of the woman, ascertain with considerable certainty whether her system has ever been infected. References should also be obtained and consulted, and, if practicable, the physician who has attended her be communicated with.

It is safer to employ a wet-nurse, two months after her confinement than previously, for if she have the syphilitic taint it will by this time show itself in the innutrition, coryza, and anal sores of her infant.

There are, also, among the women who present themselves for wet-nursing in the cities, many of a scrofulous habit, and many who possess an hereditary tendency to tuberculosis, if indeed they do not already have the incipient disease. Such applicants should be rejected, on account of the poverty of their milk and the probability that they will not be able to endure the debilitating effect of lactation.

The milk should be examined, in order to ascertain its richness and quantity, and whether it contain colostrum. If there be colostrum after the eighth day, it is probable that there is some fault in the health or digestion of the wet-nurse, and that her milk may disagree with the infant. It is not necessary that the breast should be large, in order to furnish a sufficient quantity of milk, since, as has been already stated, in some the secretory function is active during the time of each nursing, so that, although the breasts are of moderate size, a sufficient amount of milk is furnished. The nipples should be well formed and prominent, and preference is to be given to those wet-nurses in whom blood-vessels are seen ramifying over the breasts.

By examination of the milk, its degree of richness can be readily ascertained. A quantity of it should be placed in a test-tube, and the cream which rises to the top indicates, approximately, the character of the milk. Good milk furnishes three per cent of cream, and the casein and sugar usually correspond in quantity with the cream. An instrument has been invented, called the lactometer, by which the exact amount of the cream can be ascertained. It is simply a tube graded into 100 divisions. It is placed upright and filled with milk, and the number of divisions occupied by the cream indicates its proportion in 100 parts. The lactoscope is another instrument employed for the purpose of ascertaining the richness of the milk. It consists of two concentric tubes, which move upon each other. Milk which we wish to examine is poured within the tubes sufficient to obscure a light viewed through it, three feet distant. The column of milk is then diminished, till the light begins to be visible. The size of the column indicates the degree of opacity and the richness. The lactoscope was invented by M. Donné, and is described by him.

Dr. Minchin recommends a simple mode of determining the richness of cow's milk, and it would equally answer for the breast-milk. A vessel holding about one ounce, and containing a graduated enamel slab, passing diagonally from above downward, is filled with milk. It is then covered with a glass slide carried over it in such a way as to exclude bubbles. The number of degrees which can be read, indicates the character of the milk, as regards its richness.

Examination of the milk by the microscope not only enables us to determine whether there are abnormal corpuscles or granular elements, but also its richness. It should be examined before the cream has separated. Oil-globules of small size, and few, indicate poverty of the milk; very large oil-globules are said to indicate milk which is apt to be indigestible, especially in feeble infants. Such are the free globules of the colostrum. Numerous oil-globules of medium size indicate nutritious milk. Vogel, in 1850, made the discovery of vibriones in human milk. The fact is established that these animalcules may be generated in the milk within the breast, though such cases are not frequent. Dr. Gibb describes a case which he met. (*Ranking's Abstract*, vol. xxxiv.) An infant, seven weeks old, wet-nursed by its mother, who had the appearance of perfect health, was, nevertheless, ill-nourished and emaciated. It had no diarrhœa or other apparent disease, and the milk was therefore examined. Vibriones baculi were found in the milk immediately after it was obtained from the breast. The milk had the usual amount of cream, and seemed, to the naked eye, of good quality. According to Dr. Gibb, two genera of microscopic organisms occur in the milk, namely, vibriones and monads. It is believed that the monads occur in consequence of fermentation of the sugar and the production of lactic acid. Vogel also attributed the production of the vibriones to fermentation occurring in consequence of heat and congestion of the breast, connected with sexual excitement. This explanation is probably not correct, because vibriones sometimes occur when there is no unusual heat of breast, and no evidence of fermentation. The fact that such organisms may be found in milk which seems of good quality

to the naked eye, affords additional proof of the usefulness of the microscope in the selection of a wet-nurse.

Many wet-nurses have a return of the menses as early as the fourth or fifth month after delivery. The reëstablishment of this function in some women impairs the quality of the milk, so as to render it less nutritious, and perhaps less digestible during the time of the catamenial flow, as we have stated in a preceding paragraph. In the selection of a wet-nurse, then, preference should be given to one who does not have the periodical sickness; but if she be already employed, and give satisfaction, the reappearance of the catamenia does not indicate the need of the change of nurse, unless the digestion of the infant be disordered, or its nutrition be impaired.

In the selection of a wet-nurse, attention should also be given to her mental and moral traits. Cheerfulness, affection, veracity, and a proper appreciation of the responsibility of her situation, enhance greatly the value of a wet-nurse. Not less important are habits of temperance and cleanliness. I could cite cases of the most melancholy results from the absence of these traits. In one case, idiocy resulted from an infant falling upon the pavement from the arms of a reckless or intemperate wet-nurse.

In most cases, the mode of examination indicated above suffices to show the character of a wet-nurse, so far as her health and milk are concerned. It should be borne in mind, however, that the microscope does not always reveal deleterious properties in the milk. Elements which are in a state of solution, and are invisible, may occur in excess, so as to impair the quality of the milk and render it indigestible. The following case, in which the saline ingredients seem to have been in excess, is related by Dr. Hartmann (*British and Foreign Medical Review*, vol. xii.): "An infant, whose mother was in good health and had borne several children, exhibited a healthy appearance for the first five weeks after birth. The alvine evacuations then became copious, fluid, and discolored, and the child lost flesh and strength. After the usual remedies had been vainly administered for a fortnight, the mother remarked that the child did not take the right breast willingly, and so much did the unwillingness increase, that at length the mere application of the nipple to the child's lips occasioned loud crying. On examination it was found that the milk of the right breast had a distinctly saline taste; whereas the milk of the opposite breast was of the ordinary sweetness; no difference of consistence or color was discoverable. From that time the child was only allowed to nurse the left breast, and in a few days all diarrhœa and sickliness of appearance vanished." In this case there was no appreciable disease of the breast, although its secretion was perverted. The deleterious character of the milk was discovered, not by any change in its appearance, but by the taste.

It is obviously very necessary, before recommending a wet-nurse, to ascertain whether she will probably furnish sufficient milk; for however excellent she may otherwise be, if she do not satisfy the wants of the infant she obviously should not be employed. The only certain way of ascertaining whether she have or have not sufficient milk is by weighing the baby before and after the nursing, and observing whether the difference in the two weights corresponds with that given in the tables in Chapter VII.

CHAPTER VI.

COURSE OF LACTATION—WEANING.

After the birth of the infant, the mother needs rest a few hours—four or five, or a little longer in tedious and exhaustive cases—and then it should be applied to the breast. There is frequently a little milk at this time, and the act of nursing promotes the secretion, and increases the quantity. The full secretion is not, however, established before the third day, and though the infant be applied to the breast often, it obtains but little milk. Infants are so constituted that they require but little food until it is naturally provided for them, and the common practice of feeding them to repletion with various sweetened mixtures almost as soon as life begins, because they obtain little breast-milk, is to be deprecated. Filling their stomachs in this way has a tendency to prevent their drawing upon the nipples with the avidity which is required to stimulate a free flow of milk. Besides, as I have many times observed, indigestion, diarrhœa, and sprue, are common results of this injudicious feeding. If, therefore, the infant be applied to the breast every second hour when the mother is awake till the third day, and be fed nothing besides, there need be no anxiety as regards its nutrition. If on the third day the breasts do not begin to fill, and the secretion be delayed, a little fresh cow's milk, diluted with double its quantity of warm water, and slightly sweetened, should be given every fourth hour, but should be withheld as soon as the flow of milk occurs.

Infants under the age of one month should nurse about every hour by day and at longer intervals by night, or about ten times in twenty-four hours, for the stomach of the new-born holds but little, and, therefore, receives but little at each nursing, and its digestion is active. The interval should be longer at night than in the daytime, so as to allow the mother more sleep. In the second month the interval should be about two hours, and it should be gradually lengthened as the age increases, so that after the fourth month nursing should be about every third hour, and after the sixth month, when the use of some artificial food is proper, every fourth hour.

The infant should be habituated to nursing at regular intervals, and when it is, it will ordinarily awaken at about the proper time. The practice on the part of the mother of applying the babe to the breast whenever it frets, and as a means of quieting it, although it have but just nursed, is pernicious and should be forbidden. Giving the stomach no time to rest or filling it to repletion, tends to produce indigestion and diarrhœa, and to increase the fretfulness. The cause of the fretfulness should be sought for, that the proper measures may be applied. In ignorance of the cause, it is better to quiet the restlessness by carrying the child, or even by rocking it, than to increase the task of the diges-

tive function. Fretfulness of infants is often due to colic or griping produced by irritating products of imperfect digestion in the intestines, and the addition of more food has a tendency to increase rather than to diminish it.

While regularity in nursing is required, still, as M. Donné has said, mathematical exactness in this matter would be ridiculous. Quiet natural sleep of a well-nourished infant should not be interrupted in order to give it the breast, unless the sleep be unusually protracted. It will usually awaken when the system requires more nutriment. Ill-nourished infants often sleep but little, making known their want by crying and fretfulness, until they become wasted and prostrated, when they are drowsy in consequence of passive congestion of the brain. This drowsiness is evidently a pathological symptom. It shows the need of increased nutrition. It is due to scantiness of milk or milk of poor quality, and the infant should be aroused frequently for the purpose of giving it nutriment or even stimulants. The breast-milk is sufficient for its nutrition till the age of six or eight months, provided that it is abundant and of good quality. Therefore, if the mother be strong, and experience no exhaustion from suckling, no other nutriment need be given till that age.

Many mothers, however, by the third or fourth month of lactation, find that they have not sufficient milk to meet the wants of the infant. The constant drain upon their systems sensibly impairs their health. In such cases it is proper to commence with a little feeding from the spoon or bottle, and increase the quantity given as the infant grows older. Great care is, however, requisite in the preparation of food for so young an infant, whose digestive organs are still feeble and easily deranged. In the country, where diarrhœal affections and the so-called gastric derangements are not frequent, the danger from artificial feeding is less than in the city, and in the cool months in the city the danger is less than in the summer season. Infants of the city, between the months of May and October, have a strong predisposition to diarrhœal attacks, the result of antihygienic influences which surround them. Errors of diet in their case readily provoke disease or derangement of the digestive organs, often of a severe and dangerous form. Moreover, experience has shown that artificial feeding, during the period when nature designed that they should be nourished by lactation, very commonly produces in the hot months more or less vomiting and diarrhœa, followed by emaciation and other evidences of malnutrition. Therefore an exception must be made, in case of the city infant, as regards the commencement of artificial feeding. If it be under the age of one year, it should be nourished exclusively, or almost exclusively, at the breast during the hot months, when practicable, even if the mother suffer somewhat in her health from the constant drain upon her system. It should, however, receive the amount of nutriment which it requires, and, if there be not sufficient breast-milk, it will be necessary to supply the deficiency by artificial feeding. The reader is referred to Chapter VIII., for facts relating to the subject of artificial feeding.

No fixed rule can be stated in regard to the time when it is proper to

allow artificial food in addition to the breast-milk. While robust mothers with abundant milk can satisfy their infants till the age of six or seven months, many begin to feel the drain upon their systems and have an insufficient supply by the third or fourth month, and it is necessary to supplement the nursing by the use of artificial food, a smaller or larger quantity, as the case may require. The deficiency may be supplied by the use of food prepared as recommended in Chapter VIII. At six months also, or even at four or five months, if the infant appear anæmic and ill-nourished, it may be allowed occasionally one or two teaspoonfuls of beef-juice, expressed from slightly boiled beef, two or three times daily. At the age of eight months, semi-liquid food may be given. Pap, prepared with stale bread or a rolled soda cracker, may also be given once or twice daily, between the times of nursing, and occasionally beef-tea or chicken-broth, thickened with cracker or bread, is taken with relish, and if well prepared and given no oftener than once or twice a day, it is commonly readily digested, while it is highly nutritious. If the quantity of breast-milk diminish, as it often does, toward the close of the first year, artificial food should be given oftener, so as to supply the deficiency. Solid food requires considerable development of the digestive organs for its ready assimilation. It should not, therefore, be given till the close, or near the close, of the first year.

Weaning ought to take place, as a rule, between the ages of ten and twelve months. It is well, if the mother's health be good and her milk sufficient, to defer weaning till the canine teeth appear. The infant then possessing sixteen teeth, is able to masticate the softer kinds of solid food. Weaning should be gradual. Mothers often speak of weaning on a certain day. They have given but little artificial food, and have suckled at regular intervals, till at a fixed time they have denied the breast altogether. This abrupt change of diet should be discouraged. It should only be recommended under peculiar circumstances. It is apt to derange the digestive organs, and it causes fretfulness and sleeplessness on the part of the infant for a week or more. Weaning should commence by feeding with a spoon, a little oftener through the day, and nursing less, and by discontinuing the practice of suckling at night. The infant tolerates this gradual change of diet, while it rebels against sudden weaning, and by its fretfulness increases greatly the care and trouble of the mother. Nurslings in the city should not be weaned in warm weather, nor within a month immediately preceding it. If the mother's health fail, or her milk become deficient in the summer months, so that she cannot continue suckling, the infant should be sent immediately to the country, or a wet-nurse be employed. Many lives are sacrificed in consequence of ignorance of the danger of weaning under the circumstances mentioned. Severe diarrhœa, inflammatory or non-inflammatory, is apt to result. This subject will be considered elsewhere.

CHAPTER VII.

QUANTITY OF FOOD REQUIRED IN INFANCY AND CHILDHOOD.

The quantity and quality of food required in infancy and childhood is a subject of the highest importance, and one in regard to which much ignorance prevails. Children need food more frequently than adults, and they suffer more from hunger if their meals are delayed beyond the usual time. Their tissues undergo more active molecular change than those of adults, so that they need more nutriment for the waste, and they require additional nutriment for the purposes of growth. It is during infancy that the most disastrous consequences follow from errors in nursing or feeding. Numberless infants every year, and especially in the summer months, lose their lives from this cause. Improperly fed, they soon show symptoms of indigestion and gastrointestinal catarrh. Their food, if unsuitable in quality or too abundant for their digestive function, is assimilated with difficulty, and only in part. More or less of it undergoes fermentation, producing lactic and butyric acids, and other irritating products, which cause diarrhœa; and if the error is not soon corrected, the catarrh of the alimentary tract thus established results in waste of the tissues, and, finally, a marasmic condition occurs, in which the child perishes, or from which it very slowly recovers under better diet and improved hygienic surroundings.

So important to the welfare of young children is the diet, both as regards its quantity and quality, and the times of feeding, that this subject has attracted much attention, and many infant foods have been prepared, which are found in the shops. Both underfeeding and overfeeding, as well as the use of improper diet, produce ill-effects. If infants be underfed, they fret, and lose flesh and strength; if overfed, they may vomit the surplus food, but if this do not occur, that portion which is not digested undergoes fermentation, with the formation of the irritating products mentioned above.

Appreciating the importance of a correct knowledge of the amount of food required by infants, certain physicians have made careful observations in order to ascertain it. M. Parrot (L. Athrepsie, Paris, 1877) weighed infants before and after each feeding with cow's milk. The number of feedings was six in twenty-four hours. His observations were scarcely sufficient in number for accurate deductions, but he concluded from them that the quantity of cow's milk required in twenty-four hours is as follows: "9½ ounces for the first month; 19 ounces for the second, third, fourth, and fifth months; and 25 ounces for the sixth month." This estimate is for pure cow's milk used without dilution. The use of milk in its pure state and undiluted, he considers preferable to its dilution. After the sixth month he thinks that 4½ to 6½ ounces for each month should be added to the quantity previously employed.

Meigs and Pepper mention the case of an infant of four months that took 36 ounces of breast-milk daily, and another of five to six weeks, that took 18 to 23 ounces daily. The same authors cite the observations of M. Bouchard, who concludes from weighing infants, that while the new-born require much less breast-milk than those who are older, 20 ounces daily are needed between the ages of one and three months, 23 ounces after the third month, 27 ounces after the fourth month, and 30 ounces between the ages of six and nine months.

A few years since, Drs. Chadbourne, Parker, and myself, made observations in the New York Infant Asylum and New York Foundling Asylum, in order to determine how much food children required at different ages. Those selected for observation were well nourished, and they were accurately weighed before and after each nursing or feeding during twenty-four hours. Eleven infants under the age of three weeks, who nursed, with three exceptions, twelve times in twenty-four hours, were found to take in the average in the day and night 12.55 ounces, as seen by the following table:

TABLE I.—*New-born Infants; those under the Age of Three Weeks.*

No.	Name.	Age.	No. of nursings.	Milk nursed in 24 hours.	
				Quantity in weight.	Quantity in fluidounces.
				Oz *Dr.*	
1	Josephine Foley	17 d.	11	10 ½	9.75
2	Henry Cunningham	16 d.	9	13 5	13.24
3	Henry Jackson	19 d.	9	10 3	10.07
4	—— Rake	5 d.	12	22 7	22.22
5	Henry Benton	6 d.	12	15 5½	15.25
6	Wm. Fletcher	5 d.	12	10 1½	9.88
7	Nora Hastie	14 d.	12	17 3	16.85
8	Carl Flask	5 d.	12	5 4	5.37
9	Frederick Dighle	7 d.	12	14 4	14.08
10	Edward Stace	6 d.	12	8 1	7.74
11	Rosa Brown	3 w.	12	14 1	13 68

The above statistics correspond with those of other observers. They show that infants under the age of three weeks take in the average about half the milk required by those over the age of two or three months. After the third week, the amount needed for healthy nutrition gradually increases with the progressive growth of the infant.

TABLE II.—*Ages; from One Month to Ten Months.*

No	Name.	Age.	No. of nursings.	Milk nursed in 24 hours.	
				Quantity in weight.	Quantity in fluidounces.
				Oz. *Dr.*	
1	Agnes Sunkle	6 m.	8	26 1½	25.3
2	Jessie Bradley	4 m.	9	38 ½	36.8
3	Walter Gorman	3½ m.	8	24 2	23.5
4	Lottie Brooks	7 m.	10	27 3½	26.6
5	Willie Loenard	5½ m.	11	28 7	28.0
6	John Clay	5 m.	10	29 7	29.0
7	Agnes West	3½ m.	8	19 2	18.6
8	Freddy Van Buren	2 m. 10 d.	7	24 4	23.7
9	Eddie Wilson	6 m.	10	12 4½	12.2
10	Frank Smith	3½ m.	8	26 7	26.1
11	Sarah White	4 m.	8	23 5	22.9
12	John Gafney	9 m.	8	24 1½	23.4
13	Bernhard Joseph	7 m.	8	27 4	26.6
14	Thomas Cole	6 m.	10	26 6½	26.0
15	Astie Russell	6 m.	10	21 6	21.1
16	Clarence Humphrey	1 m. 5 d.	8	11 1½	10.84

The second series of observations related to infants between the ages of one and ten months. It was found that they received in the average 23.79 fluidounces of breast-milk in twenty-four hours. The number of nursings in the day and night varied from seven to ten. Therefore infants between the age of one or, perhaps more accurately, two months and ten months, if they take the breast eight times in twenty-four hours, receive three ounces at each nursing; if they take the breast twelve times, they receive two ounces each time.

The following observations were made by me in private practice. All the infants were well nourished, having the symptoms of normal hearty digestion. An infant since the age of four weeks, and at the time of my observation six weeks old, took at each feeding one and a half ounces of milk, one and a half ounces of water, and one teaspoonful of Liebig's food. When three or four weeks old, it took at each feeding one ounce of cow's milk, one ounce of water, and one teaspoonful of Liebig's food. It was fed six times in twenty-four hours. A second infant of eight weeks, large and rugged, took eight times daily two ounces of milk, two ounces of water, and two scant teaspoonfuls of Liebig's food. A third infant, aged two months, took at each feeding, eight times daily, one teaspoonful of Liebig's food in seven tablespoonfuls of milk and water in equal parts. A fourth infant, aged one month and three days, fed every hour the mother stated, but perhaps the interval was longer at night, took in twenty-four hours forty-seven tablespoonfuls of the following mixture, or about two tablespoonfuls at each feeding: one heaped tablespoonful of Borden's condensed milk, one tablespoonful of lime water and ten of water. A fifth infant, which seems to have been a very hearty feeder, aged six months, took at each feeding and nine times in twenty-four hours, peptonized milk prepared as

follows: One tablespoonful of peptogenic powder (Fairchild's, designed to peptonize the milk), four tablespoonfuls of milk, four of water, and one of cream. The large quantity of nine tablespoonfuls at each feeding did not seem to produce any gastric distress.

The above observations are designed to show the average amount of milk required by the infant, but some infants, like adults, need considerably more food than others, and the infantile stomach is so distensible that it holds more without discomfort than would seem possible in viewing it in the cadaver. Thus the infant of four months, observed by Meigs and Pepper, took thirty-six ounces of breast-milk in twenty-four hours, without apparent discomfort, and with a healthy and robust development of his system, while one-third less would have been sufficient for another infant. Of course, if the breast-milk furnished to the infant be too watery and deficient in nutritive properties, or if the cow's milk with which it is fed be too much diluted, the quanity of food which it takes and requires will be in excess of the average quantity. Thus the infant of six months alluded to above that took four tablespoonfuls of milk, four of water, and one of cream, would probably have done as well with two less tablespoonfuls of water, since in the smaller quantity it would have taken the same amount of nutriment. The importance of the above observations is apparent, for they enable us to determine approximately how much food should be given at each feeding to infants that are unfortunately deprived of the breast-milk. The quantity required, as indicated by these observations, may be stated as follows: Under the age of three weeks, from one ounce to one and a half ounces of cow's milk, diluted and prepared after it is measured, so as to resemble so far as possible breast-milk, should be given at each of the twelve daily feedings. The quantity should be gradually increased as the infant grows older until the age of three months, when three ounces should be given at each of the eight feedings. It should be properly diluted after it is measured. Some infants do not seem to require an increase of this amount, but others who are hearty, need more. Thus infant No. 2, in the second table, at the age of four months, took in the average four ounces of breast-milk at each of the nine nursings in twenty-four hours. At the age of six months, the infant should be fed every three hours, and four ounces of milk may be given at each feeding, in order to insure a sufficient quantity. Some require less than this amount, and occasionally one needs a little more, as four and a half or even five ounces.

TABLE III.—*Observations Relating to the Diet during Twenty-four Hours, of Twenty-eight Healthy Children, between the Ages of Two and Three Years, with an Average Age of Two Years Eight Months.*

	Total amount.	Average for each.
BREAKFAST.		
Bread	6 lbs. 4 oz. 1 dr.	3.5 oz.
Butter	13 oz. 5 dr.	0.45 oz.
Milk	22 lbs. 14 oz. 2 dr.[1]	12.7 fl. oz.
DINNER.		
Meat	8 lbs. 0 oz. 5 dr.	4.6 oz.
Potatoes	6 lbs. 13 oz. 7 dr.	3.9 oz.
Milk	17 lbs. 9 oz. 7 dr.	9.4 fl. oz.
SUPPER.		
Milk	19 lbs. 12 oz. 1 dr.	10.5 fl. oz.
Bread	7 lbs. 1 oz. 2 dr.	4.0 oz.
Butter	14 oz. 7 dr.	0.53 oz.

DAILY AVERAGE FOR EACH CHILD.

Bread	7.5 oz. avoir.
Butter	0.98 oz. "
Meat (beef)	4.6 oz. "
Potatoes	3 9 oz. "
Milk	32.6 fl. oz.

TABLE IV.—*Observations upon Twelve Children between the Ages of Three and Six Years: Average Age, Four Years Ten Months.*

	Total amount.	Average for each.
BREAKFAST.		
Bread	4 lbs. 6 oz. 3½ dr.	5.86 oz.
Butter	5 oz. 2 dr.	0.427 oz.
Milk	280 fl. oz.	23.3 fl. oz.
DINNER.		
Beef	9 lbs. 1 oz. 3 dr.	12.1 oz.
Bread	1 lb. 0 oz. 1 dr.	1.6 oz.
Rice	9 lbs. 12 oz. 7 dr.	13.0 oz.
Milk	112 fl. oz.	9.3 fl. oz.
Butter	2 oz. 2½ dr.	...
SUPPER.		
Bread	2 lbs. 4 oz. 1½ dr.	3.0 oz.
Butter	5 oz. 5½ dr.	...
Milk	192 fl. oz.	16.0 fl. oz.

DAILY AVERAGE FOR EACH CHILD.

Milk.	48.6 fl. oz.
Beef	12.1 oz. avoir.
Rice	13.0 oz. "
Bread	10.3 oz. "
Butter	1.08 oz. "

[1] 354.6 fluidounces.

TABLE V.—*Observations Relating to the Diet of Twenty-four Children, Twelve Boys, Twelve Girls, between the Ages of Four Years and Ten Years: Average, Six Years Ten Months.*

	Total amount.	Average for each.
BREAKFAST.		
Bread	7 lbs. 13 oz. 3 dr.	5.21 oz.
Butter	12 oz. 3½ dr.	0 51 oz.
Milk	348 fl. oz.	14.5 fl. oz.
DINNER.		
Roast beef	18 lbs. 11 oz. 0 dr.	12.46 oz.
Potatoes	15 lbs. 8 oz. 3 dr.	10.30 oz.
Bread	1 lb. 6 oz. ½ dr.	0.92 oz.
Milk	192 fl. oz.	8 0 fl. oz.
Butter	4½ dr.	0.012 oz.
SUPPER.		
Bread	6 lbs. 2 oz. 3½ dr.	4.1 oz.
Milk	384 fl. oz.	16.0 fl. oz.
Butter	11 oz. 5½ dr.	0.16 oz.

DAILY AVERAGE FOR EACH CHILD.

Roast beef	12.46 oz.
Bread	10.23 oz.
Potatoes	10.3 oz.
Butter	0.99 oz.
Milk	38.5 fl. oz.

Compare the above observations with those of Professor Dalton, who estimates that a healthy adult taking active exercise requires each day—

Meat	16 oz.
Bread	19 oz.
Butter	3½ oz.
Water	52 oz.

while one leading a sedentary life needs considerably less.

It will be seen by the above tables, that even more food appears to be needed during the period of childhood than in adult life. We would suppose this to be so without statistical evidence, for the active exercise and rapid and progressive growth of this period necessarily require a large amount of nutriment. Moreover, while adults do well with solid food and water, statistics show that the best diet for children who have passed beyond infancy, is one of milk with solid food, for at least breakfast and supper.

Although we are able, by observations, to determine the average amount of food required in twenty-four hours, by children of various ages, it would be wrong to limit the diet to a fixed quantity, for some need more than others. A child should never go hungry after a meal. In some of the best conducted institutions of New York, the children eat of plain food all that they desire at each meal, while in other institutions the food at supper is limited, but is abundant at the other meals. As children go to bed so soon after supper, it is proper to have this meal light, and of such food as is easily digested.

CHAPTER VIII.

ARTIFICIAL FEEDING.

Occasionally the mother is unable to suckle her infant, and a hired wet-nurse cannot be or is not obtained. Artificial feeding is then necessary. In the large cities, this mode of alimentation for young infants should always be discouraged, for it frequently ends in death, preceded by evidences of faulty nutrition. A considerable proportion of those nourished in this manner thrive during the cold months, but on the approach of the warm season they are the first to be affected with diarrhœa and other symptoms indicating derangement of the digestive function. In New York City a large proportion of the artificially fed infants, who enter the summer months, die before the return of cool weather, unless saved by removal to the country. In the country, and in the small inland cities, the results of artificial feeding are much more favorable. In elevated farming sections, on account of the salubrity of the air, and the facility with which milk, fresh and of the best quality, is obtained, artificial feeding is attended by much less risk than in the cities.

Young infants, fed by the hand, obviously require food prepared so as to resemble as closely as possible human milk in its composition. Woman's milk in health is always alkaline. It has a specific gravity of 1031.7; cow's milk has a specific gravity of 1029. That of cows stabled and fed upon other fodder than hay or grass is usually decidedly acid. That from cows in the country with good pasturage is said to be alkaline, but in two dairies in Central New York a hundred miles apart, in midsummer, with an abundant pasturage, two competent persons whom I requested to make the examinations found the milk slightly acid immediately after the milking in all the cows.

The following results of a large number of analyses of woman's and cow's milk, made by König and quoted by Leeds, and of several of the best known and most used preparations designed by their inventors to be substitutes for human milk, show how far these substitutes resemble the natural aliment in their chemical characters:

	Woman's milk.			Cow's milk.		
	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.
Water	87.09	83.6	90.90	87.41	80.32	91.50
Total solids	12.91	9.10	16.31	12.59	8.50	19.68
Fat	3.90	1.71	7.60	3.66	1.15	7.09
Milk-sugar	6.04	4.11	7.80	4.92	3.20	5.67
Casein	0.63	0.18	1.90	3.01	1.17	7.40
Albumen	1.31	0.39	2.35	0.75	0.21	5.04
Albuminoids	1.94	0.57	4.25	3.76	1.38	12.44
Ash	0.49	0.14	...	0.70	0.50	0.87

The following analyses of the foods for infants found in the shops, and which are in common use, were made by Leeds, of Stevens's Institute.

Farinaceous Foods.

	1. Blair's wheat food.	2. Hubbell's wheat food	3 Imperial granum.	4. Ridge's food.	5. "A B C" Cereal milk	6. Robinson's patent barley.
Water	9.85	7.78	5.49	9.23	9.33	10 10
Fat	1.56	0.41	1.01	0.63	1.01	0.97
Grape-sugar	1.75	7 56	Trace.	2.40	4.60	3.08
Cane-sugar	1.71	4.87	Trace.	2.20	15 40	0.90
Starch	64.80	67.60	78.93	77 96	58.42	77.76
Soluble carbohydrates	13.69	14.29	3.56	5.19	20.00	4 11
Albuminoids	7.16	10.13	10.51	9.24	11.08	5.13
Gum, cellulose, etc.	2.94	Undeterm'd	0.50	...	1.16	1.93
Ash	1.06	1.00	1.16	0.60	...	1.93

Liebig's Foods.

	Mellin's.	Hawley's	Horlick's	Keasbey and Mattison's.	Savory and Moore's.	Baby sup No. 1.	Baby sup No. 2.
Water	5.00	6.60	3.39	27.95	8.34	5.54	11.48
Fat	0.15	0.61	0.08	None.	0.40	1.28	0.62
Grape-sugar	44.69	40.57	34.99	36.75	20.41	2.20	2 44
Cane-sugar	3.51	3.44	12.45	7.58	9.08	11.70	2.48
Starch	None.	10.97	None.	None.	36.36	61.99	51.95
Soluble carbohydrates	85.44	76.54	87.20	71.50	44.83	14.35	22.79
Albuminoids	5.95	5.38	6.71	None.	9.63	9.75	7.92
Gum, cellulose, etc.	...	...	...	...	0.44	7.09	5.24
Ash	1.89	1.50	1.28	0.93	0.89	Undeterm'd	1.59

Milk Foods.

	Nestle's.	Anglo-Swiss.	Gerber's.	American-Swiss.
Water	4.72	6.54	6.78	5 68
Fat	1.91	2.72	2.21	6.81
Grape-sugar and milk-sugar	6.92	23.29	6.06	5.78
Cane-sugar	32.93	21.40	30.50	36.43
Starch	40.10	34.55	38.48	30.85
Soluble carbohydrates	44.88	46.43	44.76	45.35
Albuminoids	8.23	10.26	9.56	10.54
Ash	1.59	1.20	1.21	1.21

It is seen by examination of the analyses of the above foods that all except such as consist largely or wholly of cow's milk differ widely from human milk in their composition, and although some of them—as the Liebig preparations, in which starch is converted into glucose by the action of the diastase of malt—may aid in the nutrition and be useful as adjuncts to milk, physicians of experience and close observation agree that when breast-milk fails or is insufficient, our main re-

liance for the successful nutrition of the infant must be on animal milk. Nestle's food, which consists of wheat flour, the yelk of egg, condensed milk, and sugar, and which has been so largely used in this country and in Europe, is probably beneficial mainly from the large amount of Swiss condensed milk in its composition.

Cow's milk being readily obtained, is commonly used as a substitute for human milk, compared with which it contains less water and sugar, but more butter, casein, and salts. Its composition, however, varies considerably, according to the food of the cow and other circumstances. The variations in the milk of the cow, according to the nature of its food, have been considered in a preceding chapter. It has been stated, also, that the milk first obtained in milking is most watery, since it is longer secreted than the last milk, or the "stripping." The stall-fed cow gives milk that is more acid than that of the pasture-fed cow. Again, the milk in the first months after calving is richer than after the lapse of several months.

It is obvious from the above facts, that the analyses of different specimens of cow's milk must differ greatly, and the same is true of the milk of the goat and ass, and probably of the ewe. In fact, different samples of the milk of the same animal may differ more from each other, in their chemical character, than the average milk of one animal from that of another.

The milk of the goat and that of the ass have been recommended as food for infants in preference to cow's milk, on the ground that they more nearly resemble human milk. But by reference to the foregoing table, it will be seen that more importance has been attached to this supposed resemblance than the facts justified. Neither the milk of the ass nor goat, so far as its chemical character is concerned, would seem to possess any marked advantage over cow's milk. The ass's milk is procured with difficulty, and is seldom used. An objection to goat's milk is the unpleasant odor which it often possesses, due to the presence of hircic acid. It is stated, however, by Parmentier, that this odor is only noticed in the milk of goats that have horns. An important advantage, in the city, in the use of goat's milk, is that the animal can be kept at little expense, so that even poor families who are not able to purchase and feed a cow, can generally possess a goat from which fresh milk can be obtained at any time. Preference is to be given to goat's milk, when fresh, over cow's milk brought from the country, perhaps watered on the way, several hours old when received, and in commencing fermentation. But cow's milk of good quality and free from fermentative changes, is probably not inferior to goat's milk as a food for infants, and from its abundance it must continue to be in common use for this purpose.

If the mother's milk fail, or become unsuitable from ill-health or pregnancy, and on account of family circumstances a wet-nurse cannot be employed, the important duty devolves upon the physician of deciding how the infant should be fed. Shall one of the numerous foods in the shops be employed—some of which, as Liebig's, have real merit—or shall milk be used as the sole food, or be used in combination with some other food, and if so used, what shall be the mode of combination

and preparation? In order to solve this problem it will be well to recall to mind the part performed in the digestive function by the different secretions which digest food:

1st. The saliva is alkaline in health. It converts starch into glucose or grape-sugar. It has no effect upon fat or the protein group. It is the secretion of the parotid, submaxillary, and sublingual glands, which in infants under the age of three months are very small, almost rudimentary. The power to convert starch into sugar possessed by saliva is due to a ferment which it contains called ptyalin.

2d. The gastric juice is a thin, nearly transparent, and colorless fluid, acid from the presence of a little hydrochloric acid. It produces no change in starch, grape-sugar, or the fats, except that it dissolves the covering of the fat-cells. Its function is to convert the proteids into peptone, which is effected by its active principle, termed pepsin.

3d. The bile is alkaline and it neutralizes the acid product of gastric digestion. It has no effect on the proteids. It forms soaps with the fatty acids, and has a slight emulsifying action on fat. The soaps are said to promote the emulsion of fat. Their emulsifying power is believed to be increased by admixture with the pancreatic secretion. Moreover, the absorption of oil is facilitated by the presence of bile upon the surface through which it passes.

4th. The pancreatic juice appears to have the function of digesting whatever alimentary substance has escaped digestion by the saliva, gastric juice, and bile. It is a clear, viscid liquid of alkaline reaction. It rapidly changes starch into glucose. It converts proteids into peptones and emulsifies fats. While the gastric juice requires an acid medium for the performance of its digestive function, the pancreatic juice requires one that is alkaline. These important facts should be borne in mind, that such a mistake as prescribing pepsin with chalk mixture, or the extractum pancreatis with dilute muriatic acid, may be avoided.

5th. The intestinal secretions are mainly from the crypts of Lieberkühn, and their action in the digestive process is probably comparatively unimportant, but in some animals they have been found to digest starch. It will be observed that of all these secretions that which digests the largest number of nutritive principles is the pancreatic. It digests all those which are essential to the maintenance of life except fat, and it aids the bile in emulsifying fat.

It is seen from this brief review of the action of the digestive ferments, that starch is digested in only a very small quantity by infants under the age of three months; and, therefore, that those foods which consist largely of starch afford but little nutriment at this age. The impropriety also of administering for days large quantities of an alkali, as is frequently done, is apparent from the above statement in regard to the action of pepsin, since it may retard or prevent gastric digestion.

In 1882, a conference was held in Salzburg, Germany, of physicians from various parts of the German Empire, known throughout the world as specialists in the diseases of children. The purpose of the convention was to discuss the diet of infancy and childhood. They agreed that animal milk is the best substitute for human milk in the feeding of infants, either as the main food or as the basis of the food em-

ployed. Useful as some of the preparations of the shops are as adjuvants, nevertheless, experience shows the soundness of the opinion expressed by the conference, and yet feeding with animal milk of the best quality must be carefully managed, or it will be found to disagree with the feeble and readily disturbed digestive function of the infant.

Milk should always be given at a uniform temperature of about 99°. Employed habitually too hot or too cold, it frequently produces stomatitis, or a more serious disease of the digestive organs.

Infants under the age of ten months should nurse from the nursing bottle, and this as soon as used should, with the India-rubber top and attachment, be immersed in a quart or two-quart bowl of cold water, to which a teaspoonful of sodium bicarbonate has been added, and water should be drawn through the tube and nipple by suction with the mouth.

Cow's milk, though possessing nearly the same composition as human milk, nevertheless behaves differently in some respects in digestion. The casein of human milk coagulates in light flocculi in the stomach of the infant, so as to be readily acted on by the digestive ferments, while that of cow's milk forms large and firm coagula, which are with difficulty digested. The irritating products of a slow and imperfect digestion frequently cause colic, and fever, with more or less intestinal catarrh. Cow's milk, therefore, disagrees with many infants, who suffer from indigestion in consequence of the feeding, whose stools show masses of partly digested casein, with abundant mucus, who fret from gastro-intestinal uneasiness, and vomit often, and do not thrive like infants nourished at the breast. Therefore, the profession have long felt the need of some modification of cow's milk so that it more closely resembles human milk in its digestion. This has in a measure been accomplished by the process known as peptonizing, by which the casein is digested, or so far digested that it coagulates in flakes. Peptonized milk, or milk which is partially digested by artificial means, is prepared by the action upon it of extractum pancreatis and sodium bicarbonate. We may here briefly state the method. Extractum pancreatis ʒj, and sodium bicarbonate ʒij, are added to one gill of tepid water, and this is mixed with one pint of tepid milk as fresh as possible. The mixture is allowed to stand in water having a temperature of about 100° to 110°, for half an hour, or even one hour, if it do not become bitter. After the half hour the milk should be frequently tasted, and if it be in the least bitter, it should be immediately removed from the heat, and what is not used should be placed upon ice. If it be fully digested, it is too bitter for use. If it be slightly digested, the bitterness is not appreciable, or is so slight that it is readily taken by the infant, and the casein coagulates in flakes instead of large coagula. Observations in feeding in the New York Foundling Asylum, appeared to show that infants under the age of three months did better, if one pint of water instead of one gill were used with the pint of milk. Prof. Leeds recommends the following method as an improvement. In his opinion it produces milk so closely resembling breast-milk in its chemical character and behavior, that he designates it humanized cow's milk:

"1 gill of cow's milk.
1 gill of water.
2 tablespoonfuls of rich cream.
200 grains of milk-sugar.
1¼ grains of extractum pancreatis.
4 grains of sodium bicarbonate"

"Put this in a nursing-bottle, place the bottle in water made so warm, that the whole hand cannot be held in it without causing pain longer than one minute Keep the milk at this temperature for exactly twenty minutes. The milk should be prepared just before using." Messrs. Fairchild have prepared according to the above formula what they designate a peptogenic powder in a can accompanied by a measure which holds sufficient for peptonizing two ounces of milk with half an ounce of cream.

Peptonized milk is an useful addition to the dietetic preparations for infants. By peptonizing is accomplished what physicians have long felt the need of, to wit: a mode of preparing cow's milk, so that its casein coagulates in flakes like that of human milk. Milk employed for this purpose should be as fresh as possible, but unfortunately in hot weather when there is most need of having a food for artificially fed infants, which bears the closest possible resemblance to human milk, in order to prevent the summer diarrhœa, much of the cow's milk when it reaches the cities twenty-four hours after the milking, has begun to undergo fermentation, and is therefore unsuitable for peptonizing, though employed for this purpose. This is probably one of the chief causes of the fact that peptonized milk not unfrequently disappoints our expectations, so that we find that the patient does better if fed with condensed milk or one of the foods of the shops. The peptonizing of milk rests on a scientific basis, and as clinical experience thus far has demonstrated the usefulness of milk prepared in this manner in the feeding of infants in a certain proportion of cases, it will probably continue to be regarded as one of the best substitutes for breast-milk. It has also been found useful for children with feeble digestion, who have passed beyond the age of lactation.

If for any reason cow's milk be not peptonized, an alkali added to it retards coagulation, and tends to prevent the formation of large and thick curds. If therefore the child vomit curds, or pass fragments of them in the stools, lime water may be added, or the carbonate of sodium as recommended by Vogel, who dissolves one drachm of the carbonate in six ounces of water, and adds a teaspoonful to the milk at each meal. A more effectual way to prevent the formation of large and firm caseous coagula, is to mix with the milk some bland and easily digested farinaceous food, as Liebig's which, by mechanically separating the caseous particles, prevents the formation of large masses; and which, while it has nutritive properties, dilutes the milk and enables the digestive fluids to act more readily upon it.

It is known that infants prior to the third month can digest only a very small amount of starch, since the salivary and pancreatic glands, whose secretions convert starch into glucose, a necessary change in digestion, are almost rudimentary in the first months of infancy. In

a monograph relating to *Infant Diet* written by Professor A. Jacobi, and revised, enlarged, and adapted to popular reading by Dr. Mary Putman Jacobi, it is stated that the parotid glands which, together, weigh 80 grains at fifteen months, and 120 grains at two years, weigh but 34 grains at the age of one month. In several instances we weighed the pancreas taken from the bodies of infants who had died under the age of six months in the New York Infant Asylum. Its weight was very different in those whose ages were about the same; in several under the age of four months it was less than one drachm, and in some more than one drachm; but in no instance did it reach two drachms. The submaxillary and sublingual glands, which also secrete a liquid that is designed to convert starch into glucose, are comparatively insignificant in young infants, so that the combined action of the parotid, submaxillary, sublingual, and pancreatic secretions, must be inadequate for the saccharification of the starch which ordinary farinaceous food contains, during the first three or four months of infancy.

But it is now ascertained that the salivary and pancreatic secretions are not the only agents by which starch is digested. The mucous surface furnishes an "epithelial ferment, which assists in the change, so that the secretions from the buccal and intestinal surfaces materially aid in the digestion." (*Revue des Sciences Méd.*, 1879, by Charles Richert; also remarks by Professor Flint, Jr., in *Physiol. of Man.*)

It appears, therefore, that young infants are able to digest a certain amount of starch, but a much smaller proportion than those who are older; and the preparation of a farinaceous food in which saccharification of the starch is effected by a chemical process, and the delicate and easily deranged digestive organs of the infant relieved of the task, has long been a desideratum.

The late Baron Liebig, who devoted considerable time in the last years of his life to the study of the food of infants, prepared such an article, widely and favorably known as Liebig's food. It is found in the shops bearing the names of the parties in whose laboratories it is prepared. The preparations of it in common use are Hawley's, Horlick's, Mellin's, Keasbey & Mattison's, and the baby sup. As regards Keasbey & Mattison's, Horlick's, and Mellin's Liebig's food, chemical examination shows that in samples from the laboratories of these gentlemen the conversion of starch into glucose and dextrin is complete.

The following statements indicate the nature of Liebig's food, and the way in which it is prepared. Starch is transformed into sugar and dextrin, a change which, when farinaceous substances are used in the usual way, is effected in the system, and thus the digestive organs are relieved from a part of the burden of digestion.

"The following is the best way of preparing this food: Half an ounce of wheaten flour, and an equal quantity of malt flour, seven grains and a quarter of bicarbonate of potassium, and one ounce of water, are to be well mixed; five ounces of cow's milk are then to be added, and the whole put on a gentle fire. When the mixture begins to thicken, it is removed from the fire, stirred during five minutes, heated and stirred again, till it becomes quite fluid, and finally made to boil. After the separation of the bran by a sieve, it is ready for use.

By boiling it for a few minutes, it loses all taste of the flour." (London *Lancet*, January 7, 1865; *Braithwaite's Retrospect*, July, 1865.)

This food, according to Liebig, furnishes double the amount of nutriment contained in milk; or, as he expresses it, is a "double concentration" of that secretion.

Dr. Hassell, in a communication in reference to this food to the London *Lancet* for July 29, 1865, says: "It appears to me that the great merit of Liebig's preparation consists in the use of malt flour as a constituent of the food; this, from the diastase contained in it, exercises, when the fluid or soup is properly prepared, a most remarkable influence upon the starch, quickly transforming it into dextrin and sugar, so that in the course of a few minutes the food, from being thick and sugarless, becomes comparatively thin and sweet."

Liebig's food should be used with milk, in varying proportions according to the age of the child. Among the many foods found in the shops besides Liebig's, Nestle's should be noticed, since it is favorably mentioned by high authorities as Henoch, and is largely used with good results in many instances. It consists, as stated above, of wheat flour, yelk of egg, condensed milk, and sugar. One thousand parts contain twenty parts of nitrogenized matter and seven of salts. The samples which I have examined have been alkaline. Since it consists largely of Swiss condensed milk, no milk is to be added to it, and it is quickly prepared by boiling it a moment in nine or ten times its quantity of water. A list of the foods which have been found useful in infancy and childhood would be incomplete without mention of condensed milk.

Condensed milk is largely used in the feeding of infants. The milk is condensed in vacuo to one-third or one-fifth its volume, heated to 100° C. (212° F.) to kill any fungus which it contains, and, when canned, 38 to 40 per cent. of cane-sugar is added to preserve it. In the first month one part of milk should be added to fifteen of water, and the proportion of water should be gradually reduced as the infant becomes older. The large amount of sugar which condensed milk, preserved in cans, contains, renders it unsuitable in the dietetic rôle of the summer diarrhœa of infants. The sugar is apt to produce acid fermentation and diarrhœa in hot weather. Borden's condensed milk, freshly prepared, as dispensed from wagons, contains, I am informed by the agent, no cane-sugar or other foreign substance, and on this account is to be preferred to that in cans. It is cow's milk of good quality, from which 75 to 79 per cent. of the water has been removed under vacuum. The chief advantage which it possesses—and it is an important one—is that it resists fermentation longer than ordinary milk. In not a few instances which have come to my notice, infants were found to do better when fed with condensed milk than with ordinary milk, or even peptonized milk, a fact readily explained by the absence of fermentation in it.

The selection and preparation of the farinaceous food to be used in milk in the feeding of infants are important. It is better for young infants, as is seen from facts stated above, that the starch, or a part of the starch in their food, be converted into glucose before the admixture. This can be accomplished if a few pounds of wheat flour be placed

dry in a muslin bag, so as to form a ball, and boiled three or four days in water sufficient to cover it. The flour grated from it has the yellowish color of glucose, and gives a decided sugar reaction to Fehling's test. A small quantity of a good extract of malt, as Trommer's or Reid and Carnick's, added to a tepid gruel of any of the farinaceous substances, also transforms the starch, so that it becomes thinner and is probably more readily assimilated by the infantile digestion; or one of the Liebig's foods described above may be used, in which the starch is converted into glucose.

Meigs and Pepper, in their standard treatise, recommend for artificially fed infants the admixture of prepared gelatine or Russian isinglass with the milk, and they state that in their practice, extending over many years, infants "have thriven better upon it than upon anything else." A piece of gelatine two inches square "is soaked for a short time in cold water, and then boiled in half a pint of water until it dissolves—about ten or fifteen minutes." To this is added, with constant stirring, the milk, containing some farinaceous food. Others who have used food prepared in this manner speak well of it. Although gelatine contains little nutriment, its presence may aid digestion, and a food recommended by physicians of such experience as Meigs and Pepper is worthy of trial in cases of habitual indigestion, or of intestinal catarrh, in which the ordinary food disagrees.

Milk should be the chief article of food during infancy, but the older the infant becomes, the larger should be the proportion of solid food given with it. After the first year the food may be made of such consistence as to be given with the spoon. In the second year and subsequently, a pap may be made of stale bread boiled in water sufficient to cover it, and mixed with fresh milk, care being taken that all lumps are reduced to a pulp. Beef tea is a laxative, on account of the salts which it contains, as is also chicken tea; but a small, or moderate, amount of it may be given once a day. Stale wheat bread or soda cracker should be crumbled in it and soaked, so as to be soft. If there be diarrhœa, the ordinary beef tea should not be allowed, on account of its laxative effect, but the expressed juice may be given instead. Few vegetables are proper for infants under the age of one year, but the potato, baked and mashed so as to be like flour, may be given at the tenth or twelfth month. It contains a large amount of starch, but appears to be readily digested by infants of the age mentioned, if given once a day in moderate quantity, with a little butter and salt added. In the second year a greater variety of food may be allowed, but the full diet of the table must not be given till after infancy, or at the age of three years. In the beginning of the second year the infant is weaned. He has twelve teeth, eight incisors, and four molars, which, with their broad surfaces, are designed for chewing. Let him have now, once or twice each day, in addition to the food which has previously been employed, a small piece of roast beef, rare done and cut very fine. Other meat, as mutton, may sometimes be given instead. After the age of eighteen months, light puddings of farinaceous substances, properly prepared, as of rice and corn meal, may be added to the dietary.

All the teeth of the first set have appeared at the age of two years

and five months, and the time has now arrived when a more marked transition may be made from liquid to solid food. Certain fruits may be allowed, even before this period; as also the jellies of most berries, and of fruits, which being deprived of seeds and parenchyma are for the most part readily digested, while they give a relish to the farinaceous food with which they are eaten. Pastries as ordinarily made, whatever fruits they may contain, are too rich and indigestible for young children. The following judicious rule for the preparation of fruits for children, copied in popular treatises on hygiene of infancy and childhood, is from *Murray's Modern Cookery Book*. . . . "Put apples sliced, or plums, currants, gooseberries, etc., into a stone jar, and sprinkle among them as much Lisbon sugar as necessary; set the jar in an oven or on a hearth, with a teacupful of water to prevent the fruit from burning; or put the jar into a saucepan of water, till its contents be perfectly done. Berries and fruits thus prepared, and the fruit jellies, are best eaten spread on bread and butter, or on soda crackers."

CHAPTER IX.

BATHING, CLOTHING, SLEEP, EXERCISE.

Bathing is now recognized in all civilized countries as one of the chief promoters of bodily comfort and health. The first bathing of the infant, which is immediately after birth, should be in water at a temperature a little below that of the blood, namely, at about 96°, after which the general bath is inadmissible until the navel string is detached. In the infant, reaction of the surface when chilled is tardy and uncertain, and therefore there is great danger of catching cold when the surface is cooled by water, and does not quickly react. It is a matter of daily observation that infants become chilly and their extremities remain cool in a medium, whether air or water, in which older children and adults would have comfortable warmth. Therefore they are liable to contract bronchitis, sore throat, intestinal catarrh, or other inflammation, from very slight exposures. This fact must be borne in mind in considering the subject of bathing.

During the first year after the detachment of the navel string, the bath should be employed daily, but not longer than three minutes; during which time thorough ablution can be performed. Different authorities disagree in regard to the proper temperature of the bath during the first months of infancy. Steiner of Prague, a high authority in children's diseases, says, "During the first nine months the infant should have a daily bath a little above blood heat," . . . but most state a temperature a little below blood heat. In my opinion it should be

at 92°, which is considerably below blood heat, but which communicates a moderately warm sensation to the hand. After the age of ten months, or even of eight months for vigorous children, the temperature of the bath may be reduced to 90°, and it should not be lower than this during the remainder of infancy, or if it be used a little lower, care should be taken to produce reaction by brisk rubbing and exercise, after a short bath. At the close of infancy, namely at two and a half years, the temperature may be still further reduced, but it should not, even for the most robust children of eight or ten years, be below 78°, which is recorded on our thermometers as the temperature of summer heat, and is about that of our northern lakes during midsummer.

The rules given in the books, not to bathe or direct a child to be bathed immediately after eating, or after much exercise, when the pores of the skin are perspiring, should be heeded. The head should first be wet with the water, and Castile soap should be applied over the surface to insure cleanliness. The strongly scented toilet soaps sometimes contain rancid fats, or other deleterious substances, and should be regarded with suspicion. In hot weather a daily bath is advisable, but in the cooler months it is sufficient if the child bathe twice or three times in the week. If, from lack of conveniences, or for other reasons, general bathing be dispensed with and the surface be washed from a basin or bowl, cooler water may be used than would be proper for the general bath, and a longer time to complete bathing would evidently be required. The bath-room should be comfortably warm, and after the bath the surface should be briskly rubbed with flannel, or, in case of older children, with a suitable coarse towel, and exercise afterward encouraged to insure full reaction. In New York, in one of the largest and best managed asylums, both boys and girls are allowed to bathe, in bath-houses, in the Hudson when the water and weather are not too cool.

It may be well to add to these general remarks on bathing the recent remarkable statement of a high authority on thermometric observations and temperature, that, during hot days, a bath in hot water, employed in the hours of greatest atmospheric heat, tends to reduce the heat of body and to preserve its normal temperature during the remainder of the day. Wunderlich says, "In tropical countries and in very hot seasons, no means of cooling is so lasting as a bath or douche of very warm water."

Clothing.

One of the most important duties of the mother or nurse is the selection of clothing for children which will be suitable for their age and the season. In the matter of dress, as in that of diet, many errors are unconsciously committed. In a room of proper temperature, which during the cool months should be 70° for infants and 68° for children old enough to run about, the head should never be covered unless in case of young infants; but the sides of the head, as well as the neck and shoulders, may be lightly covered in sleep. It is the common practice to leave off the "bellyband" which is applied after birth, when the infant has reached the age of three or four months; but, from the fact

that infants so often take cold, especially at night by throwing off bedclothes, both in cool weather, when the temperature of the apartment may fall below 70°, and in summer, when there are currents of air through open windows, I advise the continuance of the band during the first year or eighteen months. In the summer it should be made of light merino, and in the winter of flannel. It should never be so thick and heavy as to be uncomfortable, or so snug as to interfere in the least with the free movements of the chest and abdomen in respiration. It should extend to and not over the ribs, and should be secured either with safety pins or a few stitches. If excoriations or prickly heat appear on the skin under the band in hot weather, a very common eruption in infancy, the surface should be dusted with subnitrate of bismuth, or a mixture in equal parts of lycopodium and oxide of zinc, and a single layer of linen should be applied over it and under the band. If the eruption be severe, it might be best to substitute a linen or soft muslin band for a time in place of the merino.

A cardinal principle in the clothing of children is that the garments should always be so loose as not to interfere in the least with the functional activity of organs. The fitting and putting on of the dress is left too much to the discretion of the nurse, who is usually ignorant of the important facts in physiology, and unwittingly and with the best intentions injures her charge. I have often interposed to loosen the dress of young infants, which was so tight as sensibly to embarrass respiration; and the case of a new-born infant has been reported to me in which it seemed probable that death resulted from this cause. Infants especially, who are so liable to pulmonary collapse and intestinal hernia, should have loose covering of both chest and abdomen. Pressure over the stomach always feels uncomfortable, and this organ, almost as much as the lungs, needs full expansion and free movement, in order to perform its function of digestion properly. The same is true also of the intestines, but they tolerate compression better, and their movements are less impeded than those of the stomach by too tight dressing. Another part, where too snug an application of the dress does very great harm, is the neck, since moderate pressure in this region may retard the circulation of blood through very important vessels, namely, those which supply the brain, or return blood from this organ. The dress about the neck should always be so loose that the four fingers of the nurse can be readily introduced underneath it. Skirts upon girls are sometimes supported by being tied tightly around the waist and over the stomach. This should never be allowed, but they should always be supported by shoulder straps, and be loose around the waist.

Clothing protects the body according to its thickness and the feebleness of its conducting power of heat. Woollen, fur, and feather garments have very low conducting power, and wool, from its plentiful supply and cheapness, must always be the material which is chiefly worn in the winter season; while cotton, and in still greater degree linen, are active conductors of heat, allowing its quick escape from any part of the body which it covers, and they are therefore the proper material for summer clothing.

The color of a garment matters little as regards the escape of heat

from the body, for whatever its color its surface next the body is necessarily dark from the exclusion of light; but the color is important as regards the absorption of heat from the atmosphere and the solar rays. Black has the highest absorptive power, while white has the least, and the mixed colors have absorptive powers which are intermediate. In experiments made with shirtings of different colors, while white received 100° F., black received 208° F. A light color is, therefore, the best to dress children in during the hottest weather.

The covering which is proper for the head of a child when outdoor, must evidently vary considerably in different seasons, and in different states of weather. Many a young child, with scanty growth of hair, has contracted that painful disease, inflammation of the ear, followed perhaps by a protracted discharge, and more or less impairment of hearing, in consequence of taking cold from insufficient covering of head and ears in inclement and changeable weather; even leaving off accidentally a band or tie to which a child is accustomed will sometimes give it a cold.

In this connection, I wish to call attention to the common and dangerous practice among the poor of allowing children to go bareheaded in the sun during the season when the atmospheric heat is highest. Not a summer passes in which I do not meet cases of inflammation of the brain, which I believe to be largely due to exposure to the sun's rays. There is no better and safer covering for the head of a child, who is allowed to go in the open air during the hot weather, than the light, cool, and inexpensive straw hat.

The feet should always be warm and dry, the shoes worn in wet weather being water-proof; and special care should be taken in the selection of shoes, that they be pliable and loose, so as to allow freedom of growth, without compression of any part. If during the period of growth proper precautions are taken in this respect, the chiropodist would have little to do in subsequent years. Corns, bunions, and ingrowing toe-nails originate from shoes hard and unyielding, or too tightly fitting.

Sleep.

The new-born infant requires from fifteen to eighteen hours' sleep each day. If it do not have this, and be wakeful, it is probably not well. It sleeps therefore most of the time when not awake for nursing, bathing, and change of clothing. As it grows older, a less and less amount of sleep is required. At the age of three years, about nine hours of sleep are needed, and it is better, for healthy development, to allow children of this age one or two hours of sleep in the middle of the day. They indeed often take it by falling asleep on the sofa, or floor, or in places where they are liable to take cold through currents of air and scant covering, if not heeded.

Much harm has been done to children who were wakeful by nurses, and mothers too, who have given them active and dangerous drugs, as laudanum or morphine, under some enticing name as soothing syrup or cordial. A wakeful and fretful child is not well. Its ailment may be

trivial or grave, but it should never, under such circumstances, receive from mother or nurse any of those proprietary mixtures, having seductive names, which the shops contain. If it need medicine, it should be examined and prescribed for by the physician. It is scarcely necessary to call attention to some accepted and important facts regarding the dormitory of children. A free ventilation is required, either through ventilators or open windows, and a sufficient number of cubic feet of air should be allowed for each sleeper. A small room should not contain more than two children. Curtains should not as a rule be employed, and no open vessels of foul water should stand in the room, or anything else which may contaminate the air. The garment worn through the day must be entirely removed and hung up away from the bed.

In the asylums of New York, where from long and abundant experience the management of children is systematized, infants and the younger children are usually put to bed between six and seven, and the older children between seven and eight o'clock; the last meal or supper, as I have stated elsewhere, being light and easily digested.

Exercise.

Exercise is an important hygienic requirement. Harm often results from modes of exercise which are not adapted to the age. Occasionally I meet cases of permanent bow-leg, which have manifestly resulted from attempts to make infants stand at the age of four or five months. They should never be encouraged to walk or stand till about the age of one year, and if they do at the age of nine or ten months let it be voluntary, and not taught by standing them upon their feet. In case of infants with rachitis, which disease is common in cities, and is characterized by a lack of lime-salts in the bones, and can be detected by great backwardness in teething, attempts to stand or walk for any length of time should be discouraged, till by the use of lime-salts and cod-liver oil, and improvement of the general health, the rachitis is cured. Much of the permanent deformity which mars the beauty and symmetry of adult life originates in rachitis and might have been prevented.

The infant before he is old enough to stand takes sufficient exercise in a way that is natural and harmless. Let him lie upon his back in the crib, or on the floor, with a blanket under his body and pillow under his head, and all his clothes loose, so as not to restrain the free movements of his limbs. A healthy infant seems to enjoy this attitude, moving all his limbs sufficiently to give them the required exercise, and evincing his delight and exuberance of life by utterances which are as expressive as words.

In the cool months of our latitude, infants should not be taken outdoor until the age of three months, and then only for a brief time in the warmest part of the day; but in the summer they should begin to receive outdoor air and exercise at the age of one month. In warm weather the face should never be covered by a veil or otherwise, and air and light should have free access to it. The rays of the sun, however, from a clear sky, should be excluded either by a parasol or the

shade of trees or houses, or by the carriage in which the infant is carried. In cold weather, or when there is a strong wind, the protection of a veil is needed. Rude tossing of infants, which is common in families, should always be forbidden. Its effect on the cerebral circulation is likely to be bad, and it involves risk of a serious accident. In one instance to my knowledge, death resulted from injury received in this way.

Walking, as it is the natural, so it is the best, exercise for the older infants and during the period of childhood. It promotes digestion when not carried to the extent of fatigue, and gives gentle exercise to all the muscles. The baby-carriage answers a useful purpose, when combined with walking. With the ordinary hired nurse it is safer for the infant to be taken out in this vehicle than in the arms, for if the nurse in careless walking should trip, great harm might result. In one instance which came under my notice convulsions and idiocy were plainly referable to the fall of an infant from its nurse's arms upon its head.

The ordinary lawn sports of childhood, as croquet for both sexes, playing ball or quoits for boys, which are rendered more exciting by the spirit of rivalry, are also useful for muscular exercise and development, while they involve little danger. The swing affords a pleasant exercise, and with the propulsion required it gives gentle but efficient activity to most of the muscles.

Many of the gymnastic exercises are too severe, involve too much risk of ruptured tendons, sprained joints, and even of dislocated or broken limbs.

Among all the ingenious inventions to provide sports and pastimes for children, there are none better than gardening and farming, where facilities will allow it, conjoined with the ordinary household duties. The healthy and robust development of the farming population, their almost complete immunity from rachitic and scrofulous ailments, is attributable to their outdoor mode of life, and the many kinds of healthful work which farm life requires. Such work is always in the highest degree beneficial for children old enough to participate in it, while it develops the habit of productive industry.

CHAPTER X.

DISEASES OF THE NEW-BORN.

Apnœa (Asphyxia) Neonati.

In the healthy infant, born under favorable circumstances, the two important functions of life, respiration and circulation, are established within the first minute. But it not unfrequently happens, in consequence of some unfavorable circumstance, that the heart and lungs

cease to act, and the infant at birth lies motionless as one dead. Sometimes in these cases an occasional pulsation of the heart can be detected when the fingers press under the left ribs, but there is no respiration. According to the nature of the cause, the surface is exsanguine or cyanotic and livid.

Causes.—These are various. The fault may be partly in the infant, from feebleness in its development; but the common causes are compression of the cord during birth, from breech presentation or otherwise, and powerful, frequent, and long-continued uterine contractions, often induced by ergot, but sometimes occurring normally, which compress the placenta, and consequently obstruct the fœtal circulation. Detachment of the placenta before birth, and protracted labor, from pelvic malformation or otherwise, even when there is no unusual severity of the pains, are occasional causes.

Treatment.—Obviously the treatment must be prompt. Mucus should be removed from the mouth and fauces with the finger, and, except in those cases in which there has been placental hemorrhage or anæmia from other causes, as exhibited by pallor of the surface, a few drops of blood should be allowed to run from the cut extremity of the cord. The flow induced aids in establishing the circulation, and, in the large proportion of cases, in which there is congestion of the internal organs, gives partial relief to it. Brisk rubbing of the body, slapping of the buttocks, blowing in the face, sprinkling water upon it, alternately transferring the body from a tub of hot to cold water, may be tried in quick succession, and, if there be no signs of returning animation, no time should be lost in resorting to artificial respiration.

The child should be placed on its side upon the edge of a table, with a blanket underneath it, and the head in such a position that the epiglottis falls forward; a towel or napkin should be placed over its face, having a hole of sufficient size to blow through, corresponding with its mouth. The physician, compressing firmly the epigastrium with his thumb, blows a full breath through the hole. A little of the air, notwithstanding the compression, enters the stomach; some may escape by the nostrils, and the rest enters the lungs. Immediately the hand, passing from the epigastrium to the thorax, compresses it gently, though with sufficient force to produce expiration. This should be repeated six or eight times per minute. The action of the heart, previously slow, becomes quicker by the artificial respiration. I have been able to produce pulsations by this method when the heart had ceased to beat for a considerable time, and death, to all appearance, had occurred. Some recommend placing the infant on the right side, on account of the position of the valve between the auricles, but I think it is better to change it from one side to the other, in order to prevent congestions, which are so apt to occur when the circulation is imperfect. The circulation always commences sooner than respiration. The first respirations are mere gasps—not more than one or two per minute in cases of decided asphyxia—but as they become more frequent, they are also deeper.

Artificial respiration should be continued fifteen or twenty minutes in cases in which no action of the heart can be detected, by pressing

the fingers under the ribs, when, if there be no signs of returning animation, the case is hopeless. If there be any pulsation, however feeble, we should not cease in the attempt at resuscitation. Some prefer insufflation through a tube (as the segment of a catheter) introduced into the larynx, and pressure upon the thyroid cartilage so as to close the pharynx, instead of upon the epigastrium. The principle of treatment is similar, but the mode which I have recommended above I have found successful beyond expectation. Thus, in one case in my practice in which pulsation in the umbilical cord had ceased from ten to fifteen minutes before birth in consequence of its prolapse, I employed artificial respiration nearly a quarter of an hour before there was any appreciable pulsation, but by perseverance the circulatory and respiratory functions were fully reëstablished, and the child lived and was vigorous. When respiration commences, insufflation may cease, but it is proper to aid the respiratory movements a little longer by compressing the thorax after each inspiration. Still, the physician may be disappointed in the result. In not a small proportion of cases the respiration continues gasping, and after a few hours, perhaps even a day, death ensues. I have made post-mortem examinations of several infants who have died under such circumstances, chiefly in the Nursery and Child's Hospital, about six from recollection, and have found considerable uniformity in the appearance of the viscera. Only a small portion of the lungs, sometimes almost none at all, was found inflated, even when the cries had for a time been strong, and extravasated blood, usually in considerable quantity, lay upon the surface of the brain, evidently having escaped from the meningeal vessels, which were in a state of extreme congestion in consequence of the protracted or difficult birth. Meningeal apoplexy, therefore, seems to me the chief cause of the ill-success attending our efforts to save those who are so far resuscitated as to be able to breathe.

Recently Professor H. L. Byrd, of Baltimore, has recommended a simple mode of resuscitation. The physician places his hands under the middle portion of the back of the child, with their ulnar borders in contact, and at right angles to the spine. Extending his thumbs, he carries forward the two extremities of the trunk by gentle but firm pressure, so that they form with each other an angle of about 45° in the diaphragmatic region. Then the angle is reversed by carrying backward the shoulders and the nates. An assistant may aid by supporting the head. By alternating these movements, Professor Byrd has succeeded in effecting resuscitation when other methods had failed, and when so much time had elapsed that the case would seem hopeless to most practitioners. The name and position of Dr. Byrd commend this method to consideration and trial. (American Supplement of *Obstet. Journ. of Great Britain and Ireland*, 1873.)

Caput Succedaneum—Cephalæmatoma.

During the birth of the child, extravasation of blood not infrequently occurs in the part of the scalp which presents. This results from the passive congestion, more or less intense according to the duration of

labor and severity of the labor-pains, which occurs in the presenting parts. CAPUT SUCCEDANEUM is the term employed to designate the swelling thus caused when located upon the head. Its seat is the loose connective tissue of the scalp external to the pericranium. The tumor is soft, painless, and usually located upon the occiput. It consists partly of extravasated blood, but largely of serum which has transuded from the congested vessels before that degree of congestion required to effect the transudation of the corpuscles was reached. I have repeatedly had an opportunity to examine this tumor in still-born infants brought from the lying-in wards attached to the Nursery and Child's Hospital, and have found when it was slight that it consisted almost entirely of serum, but ordinarily when dissected it presented the appearance of a bruise, with a large proportion of serum, the blood and serum infiltrating the scalp to a greater or less distance beyond the appreciable limits of the tumor. Caput succedaneum requires no treatment. As it lies in the loose connective tissue of the scalp, its liquid permeates the open connective tissue in every direction, and is rapidly absorbed, while the tumor disappears. The subsidence of the swelling is usually complete within forty-eight hours.

Occasionally blood is extravasated under the pericranium, detaching it from the bone. This occurs in connection with caput succedaneum, and is observed when the latter declines. The tumor thus produced is designated cephalæmatoma. It is situated upon the occipital or parietal bone, near the posterior fontanelle. Its base, corresponding with the denuded bone, is circular or oval, and it rarely crosses a suture. In exceptional instances two cephalæmatomata occur, located upon the occipital and one parietal or upon both parietal bones. The liquid, being surrounded by the firmly attached pericranium, does not escape into the surrounding tissues, as occurs in caput succedaneum, and is, therefore, more permanent. The tumor flattens slowly, and does not disappear till after several weeks. At the age of six months a slight prominence can sometimes be detected, indicating the seat of the tumor. As the pericranium elevated by the blood does not lose its vitality, it soon begins to produce bone, so that after some days a ring of new bone can be detected by the finger surrounding the base of the tumor, and on the inside of the detached membrane a layer of bone is produced, thin at first and flexible, but gradually approximating the old bone, and becoming firmer as absorption occurs.

Some time since, a specimen was presented by me to the New York Pathological Society, showing this accident and the mode of cure. The child died about two months after birth, and the blood constituting the tumor, which had been in great part absorbed, was completely incased by the old bone below and the new thin formation above. The cavity at length becomes obliterated, and there only remains some thickening of that part of the cranium which corresponds with the location of the tumor.

Meningocele, Encephalocele, Hydrencephalocele.

This is the analogue of spina bifida. An opening exists at some point in the skull, through which the meninges, or meninges with brain

substance, protrude. The deficiency is congenital, and the tumor exists at birth, or is noticed soon after. It is termed a meningocele, if only meninges protrude; an encephalocele if it contain brain substance in addition to the meninges; and a hydrencephalocele, if, in addition to the brain substance, the mass contain liquid in its interior.

The most frequent site of these tumors is the occiput, where the protrusion occurs from an opening in or at the edge of the occipital bone. The next most frequent location is the naso-frontal region. Rarely they occur upon the temporal, parietal, and basilar portions of the skull. Ordinarily, the opening in the occipital bone, through which the protrusion occurs, is at the median line, or near it, anterior or posterior to the occipital protuberance. The opening, if in the anterior part of the occipital bone, may extend to the fontanelle; if in the posterior part, it may extend to the foramen magnum. It may connect posteriorly through the foramen magnum with the cleft of a spina bifida. If the opening in the occipital bone be large, the tumor is also usually large. Prescott Hewitt cites a case in which it extended to the loins; but so large a mass consists mostly of liquid, and is rare. An occipital encephalocele contains brain substance from the cerebellum or posterior cerebral lobes, or from both. If the tumor upon the occiput be a hydrencephalocele, the liquid is from the posterior cornu of a distended lateral ventricle, or from a distended and dropsical fourth ventricle, and it occupies the interior of the tumor, the brain substance surrounding it.

FIG. 4.

If the tumor be in the frontal region, the protrusion usually occurs between the cribriform plate of the ethmoid bone and the frontal bone, and it appears externally between the nasal and frontal bones. Exceptionally, the point of protrusion is between the lateral halves of the frontal bone. The anterior lobe or lobes of the cerebrum protrude in an encephalocele in this location; if the tumor be a hydrencephalocele, the liquid is derived from the anterior cornuæ of the lateral ventricles. As a rule, the frontal are smaller than the occipital tumors, and the

skin covering them is more frequently red and vascular, so as to present the appearance of vascular tumors.

Exceptionally, the protrusion occurs from a fontanelle, or from the line of one of the sutures, so that it is seated upon the side of the skull. Cases are also on record in which the opening existed between the ethmoid and sphenoid bones, through the sphenoid, or between the sphenoid and its greater wing. Tumors in this location appear in the pharynx or mouth, or enter an orbit displacing the eye, or protrude through the spheno-maxillary fissure. The tumor, wherever it occurs, is usually an encephalocele or hydrencephalocele, the meningocele being rare. Its walls consist of skin, dura mater, and arachnoid, with intervening connective tissue. If the protrusion be at the base of the brain, of course the external covering of skin is lacking. In other locations the skin constitutes the external coat, and it may be tense and scantily covered with hair, or red and vascular. The interior of the sac is lined by the arachnoid and dura mater. These tumors, whatever the exact character of their interior, can be more or less reduced by compression, with a return of a part of their contents into the cranial cavity; but such compression usually produces cerebral symptoms, as stupor, or fretfulness, vomiting, and strabismus. The following characteristics of the three forms of these tumors aid in their differential diagnosis:

Meningocele.—Small at first, and remaining either small or of moderate size, fluctuation distinct, pedunculated, translucent, no pulsation, tense on forced expiration, reducible.

Encephalocele.—Small, base wide, no fluctuation, opaque, or sometimes translucent at the apex, distinct pulsation, enlargement by forced expiration, partly reducible, cerebral symptoms by compression.

Hydrencephalocele.—Tumor usually large, often pendulous, and its surface often lobulated, pedunculated, fluctuating; portions translucent; pulsation absent or rare. It is seldom affected by pressure, and the patient is likely to be microcephalic from the escape of brain substance external to the cranium.

These protrusions have been mistaken for various cysts, as cephalæmatoma, serous and sebaceous cysts, abscesses, vascular growths, and polypi. The fact that such errors in diagnosis have been made by various surgeons shows the importance of a thorough and careful examination before operative measures are employed.

Most patients with this deformity die in a few weeks or months. The prognosis depends on the size of the aperture, and the amount of protrusion. It is most unfavorable in hydrencephalocele, which is usually attended by deficiency of brain within the cranium, sometimes to such an extent that the patient is microcephalic, and early death unavoidable. The hydrencephalic tumor is very liable to grow, and, after a time, rupture, causing immediate death in convulsions or collapse. In meningocele, if the aperture be small, the tumor may remain small, become isolated from the cranial cavity, and the patient may live for years. But of the three forms of the tumor, encephalocele is regarded as the most favorable, since it is usually small, and patients with it not unfrequently grow up to puberty. The prognosis in these tumors

is very similar to that in spina bifida, which varies according to size of the aperture and the amount and character of the protrusion.

Treatment.—Those who have had experience with this tumor concur for the most part in the opinion that surgical interference should not be resorted to unless rupture be imminent. The mass should be protected from abrasion, and that degree of pressure should be employed which can be tolerated without producing cerebral symptoms. It is proper to draw off the liquid of a meningocele, if it be distended and likely to rupture, and the tapping may be repeated, with exceptionally the result of a cure, or of rendering the tumor stationary. Mr. Holmes has injected the tumor with two drachms of a mixture consisting of one part of tincture of iodine and two of water, allowing it to remain. And Mr. Annandale has ligatured the mass in one instance, and effected a cure. In encephalocele and hydrencephalocele, support and moderate pressure should be employed, and in the latter some of the liquid should be removed by a small trocar if rupture be threatening.

CHAPTER XI.

OPHTHALMIA NEONATI.

This disease occurs in two forms, namely, the catarrhal and blennorrhœal, and there are many cases which are intermediate.

Causes.—These are not the same in all cases. Exposure of the infant's eyes soon after birth to a bright light, catching cold, the introduction of a little of the vernix caseosa under the eyelids in the first washing, smoke, dust, and irritating gases, coming in contact with the eyes, are recognized causes. Infants living in ill-ventilated and dirty apartments, having untidy clothing, with faces and bodies seldom properly washed, and attended by dirty nurses, are more frequently affected than those in the better walks of life, and better cared for. The disease is more prevalent in asylums than in private practice, for in the former the antihygienic conditions which conduce to it more frequently abound.

The term blennorrhœal is applied to ophthalmia neonati when it is attended by an exaggerated secretion of muco-pus. It commonly results from the introduction of a particle of infective matter under the lids, during birth or afterwards, by careless handling. The gonorrhœal virus may be thus introduced, or the acrid secretion of a leucorrhœa. M. Kroner states (*Paris Méd.*, February 28, 1885) "that he found the specific gonococcus in sixty-three out of ninety-two cases of ophthalmia neonatorum." When they were absent the disease was less severe, and not likely to produce destructive effects upon the eye. He,

therefore, believes that the classification of the ophthalmia into severe and mild depends largely on the presence or absence of the specific gonococcus.

Symptoms. *Blennorrhœal Form.*—In the beginning the palpebral conjunctiva is observed to be red, a little swollen, and its cutaneous surface presents a faint reddish tinge. Light appears to be painful, and the child is fretful and sleeps but little; but the eye itself has its normal appearance. The progress of the disease, however, is rapid, and in twenty-four or thirty-six hours there is so much tumefaction that the upper lid extends over the lower, and it may be impossible to separate them sufficiently to obtain a view of the eye. The tumefaction is due to œdematous infiltration. The conjunctiva, both palpebral and ocular, now presents a deep red hue, is thickened and swollen, and numerous fine granulations appear upon it; occasionally also flakes of very delicate pseudo-membrane can be observed in addition. There is an abundant production of pus of a creamy appearance, sometimes tinged with blood, which oozes out when the lids are separated. A critical period has now arrived, one which may involve the destruction of the cornea unless the case be promptly and judiciously treated. Indeed, the gravity of the disease relates chiefly to the state of the cornea, which up to the present time, notwithstanding the severity of the inflammation and the amount of surrounding infiltration, has remained transparent and apparently unaffected. But within another twenty-four hours the cornea may lose its polish, and grayish, opaque spots of softening appear upon it. Soon perforation occurs, the aqueous humor escapes, and the iris falls forward, closing the aperture and preventing further loss of the liquids of the eye.

I have observed destruction of the cornea and loss of sight chiefly, first, in cases of true gonorrhœal infection, in which there is the maximum amount of inflammation and tumefaction, extending even over the malar bone and supraorbital ridge, with marked redness and elevation of temperature of the lids; and, secondly, with a less degree of inflammation in those who were highly scrofulous. Attention, then, to the cornea is all-important, since it can usually be saved with proper treatment, although there may so much purulent discharge and œdema that it may be impossible to see it for several days. Occasionally the cornea, instead of sloughing, becomes infiltrated to a greater or less extent, and ulcerates, but without perforation. As the patient recovers, cicatrization occurs.

The inflammation soon begins to decline. The swelling, heat, and redness of the lids and conjunctiva, and the granulations, gradually disappear, and recovery is complete, except so far as the cornea may have been injured.

Catarrhal Form.—The inflammation is from the first of a mild grade, pertaining chiefly to the palpebral conjunctiva, with but a slight discharge of purulent matter, and with little swelling or increase of heat in the lids. Attention is directed to the complaint chiefly by the secretion which collects in the angles of the lids or upon their border. There may be slight intolerance of light, and ordinarily minute granu-

lations appear upon the inflamed mucous surface. This form of the disease may disappear within a few days, or it may be protracted.

Ophthalmia of the new-born is contagious, sometimes highly so. It commences on one side, and, without precautions, commonly within a few days extends to the other.

TREATMENT.—As soon as the inflammation occurs, the opposite sound eye should be covered with a compress, kept in place by strips of adhesive plaster. This eye should be examined, however, once or twice daily, in order to detect the commencement of inflammation, and the bandage be reapplied.

Catarrhal ophthalmia requires very simple treatment. Frequently bathing the lids with lukewarm water, or milk and water, so as to remove the secretion from between the lids, suffices in a large proportion of cases. In the severer cases, lead-water constantly or frequently applied to the exterior of the lids is useful. Among the poor, mothers ordinarily bathe the lids with breast-milk, and by this simple treatment effect a cure. If the inflammation do not soon abate by this treatment, a mild collyrium of one-fourth grain of nitrate of silver to one ounce of water should be applied between the lids and allowed to run under them.

Blennorrhœal ophthalmia, on the other hand, requires prompt and judicious management. There is scarcely a disease in which delay is more disastrous.

The frequent removing of the pus is very important, which confined in large quantity underneath the closely compressed lids, by its pressure and irritation increases greatly the danger of destruction of the cornea. Therefore, the lids during the height of the inflammation should be pressed apart every hour, so as to allow the pus to escape, and the space between the lids be freed from it by a camel-hair pencil or a pledget of finely picked lint. Warm water, containing boracic acid three grains to the ounce, should be gently thrown under the lids every two hours, to wash away pus and flakes of pseudo-membrane.

Medicinal applications to the inflamed conjunctiva should, in most cases, be mild, but be frequently applied. I have used, in the treatment of purulent ophthalmia, as recommended by Professor Gross, a weak solution of corrosive sublimate applied every three hours between and under the lids, the pus, so far as practicable, having been first removed by the brush and syringe. The following is the formula, and the result has ordinarily been favorable:

℞.—Hyd. chlor. corros. . . . . gr. j;
Aquæ rosæ . . . . . ℥ij;
Aquæ . . . . . ℥vj.—Misce.

Now that bichloride of mercury has been found to be the most prompt and efficient germicide and antiseptic, the indications for its use in this disease are seen to rest on a sound therapeutic basis. In the proportion of one part to four thousand of warm water, which is nearly of the same strength as employed by Prof. Gross, and used every second or third hour, it soon diminishes the virulence of this form of ophthalmia.

Still the beneficial result which I have observed from this collyrium,

was no doubt largely due to the frequent removal of the pus, the importance of which cannot, in my opinion, be too strongly urged. In blennorrhœal ophthalmia, during the active period of the inflammation, with hot and swollen lids, linen in single thickness, or two thicknesses, squeezed out of ice-water, or, better, removed from a cake of ice, and applied every five minutes when it begins to warm, aids materially in subduing the inflammation, every moment of which, when the lids are much swollen, involves danger to the delicate cornea. This measure, therefore, which requires diligence on the part of the nurse, should be insisted on. As long as the cornea retains its transparency and polish, the eye is safe, but, as stated above, it is often difficult to obtain a view of it for some days.

The decline of the inflammation is gradual, but generally pretty rapid, yet several weeks may elapse before there is full restoration to the normal state. When the inflammation begins to abate, and the dangerous tumefaction has to a great extent subsided, a collyrium of one-fourth grain of nitrate of silver to the ounce will expedite the cure.

Occasionally granulations remain upon the lids. If they do not diminish and disappear when the purulent inflammation has ceased, I would not practise excision, as recommended by Vogel, but, having everted the lids, apply a solution of nitrate of silver, five or ten grains to the ounce, to the granulations, each second day, and immediately wash away the solution by a camel-hair pencil with salt and water, and apply a little sweet oil before the lid is returned. If the granulations do not disappear with this treatment, they may be lightly touched with the smooth surface of a crystal of sulphate of copper, followed by the application of water and sweet oil. By this mode of treatment, employed from the commencement of the inflammation, a large proportion even of the severest cases do well.

Doctor O. D. Pomeroy, oculist, has kindly favored me with the following remarks relating to the treatment of this disease:

"The first indication of treatment is thorough cleanliness. The eyes should be washed out with tepid water and salt—a drachm to the pint. This may be done every one, two, or three hours, according to the amount of discharge. The latter never should be allowed to remain in contact with the cornea long at a time, on account of its excoriating effect. A soft, old linen rag or soft sponge may be used to apply the salt water: an assistant separates the lids and the water is squeezed out of the sponge into the eye. A syringe is objectionable on many accounts; one being that the poisonous matter may be thrown against the operator's eyes. Frequently the discharge may roll into stringy masses, requiring them to be wiped away by means of the soft rag.

"If the attack be mild, I would be very slow to order astringents or stimulants. Atropine, one grain to the ounce, used three or four times daily, must always be prescribed in any case whatever, for the corneal lesions are the only ones we fear. Acid. carbol., two to four grains to the ounce, may be used several times a day with a view to stimulate the conjunctiva gently and destroy the poison. Binding up the sound eye is not much practised in infants; it is difficult to keep the dressing on; and it does not always protect the eye; further, the second eye involved

is not, as a rule, as bad as the first one. After three or four days, if the discharge become very profuse, and the tissues have a relaxed look, astringents should be prescribed, but they should never increase the irritation, and should decrease the discharge. Arg. nit., gr. ss to the ounce, may be used from one to four times daily. Aluminii et potas. sulph., gr. iv to the ounce, may be employed for the same purpose, very freely. Zinc. sulph., gr. j to the ounce, may also be used in a similar manner. After a week or ten days, if the lids still remain swollen, and there be a profuse discharge, the lids may then be everted and stronger applications made. Arg. nit., five to ten gr. to the ounce, may be brushed on every second day; carefully wash with salt and water before returning the lid to its natural position. Alum in saturated solution may be used in a similar manner, or acid. tan. gr. xx to the ounce, or cupri sulphat. in ten gr. solutions.

"*If the remedy do good to the eyes, continue; if not, change to something else, and do not, on any account, over-irritate the eyes.*

"*Cold may be applied* in the earlier stages with the tense, red, and swollen lids, and insufficient discharge, for one, two, or three days.

"The rule is to use the cold sufficiently to keep down any excess of inflammatory action. This may be known by diminished redness, heat, and swelling, and improvement in the appearance of the discharge. Cold applied about half the time is a good rule; for instance, keep it on from fifteen minutes to an hour, then leave it off for the same time; be guided by the exigencies of each case. *Scarification* of either the ocular or palpebral conjunctiva may be performed if necessary in the earlier stage if there be much swelling. The source of the injury to the cornea is from interference with its nutrition in consequence of compression and retarded circulation of the conjunctival and episcleral vessels, caused by the swelling. In scarifying the ocular conjunctiva, the incision should radiate from the corneal margin outward, and should not be deep, but enough to cause pretty free bleeding. This should be encouraged by bathing with warm water.

"*When the cornea is threatened with necrosis or sloughing*, we may meet the indication as follows: the scarification already mentioned exerts a favorable influence, but if the lids be much swollen, perhaps impossible to evert, and likely enough in a spasmodic condition pressing upon the cornea, we may perform a canthotomy—that is, pass a stout pair of scissors into the external canthus and divide the commissure by one resolute cut extending to the bone. The bleeding resulting is of service, but the power of the orbicularis to exert pressure on the eyeball is temporarily broken, which is the main indication for the operation. The cornea should be carefully observed daily to see that there is no haziness or commencing ulcer, or even any abrasion of the epithelium, for the latter is often the first sign of a commencing ulcer.

"In case the cornea be seriously involved, especially if the eyeball be too hard or tender to the touch, and the patient be suffering unusual pain, paracentesis of the cornea should be performed. Unless the operator be very skilful, a spring speculum should be used and a fixation forceps to keep the eye steady. The cornea should be pierced near its periphery, and the broad cataract needle should be passed into

the anterior chamber with its point well turned forward to avoid the lens. In this position it should be gently tilted, so as to make the wound gape, when the liquid slowly escapes; hold in this position until most of the fluid is evacuated, then withdraw the needle slowly to prevent prolapsus of the iris. This operation may be repeated every day or two if necessary. In an epidemic of purulent ophthalmia in young children, at the New York Foundling Asylum, I at first had a few cases of perforated cornea, but being more on my guard, I examined subsequent cases very carefully; when on the first signs of corneal trouble I performed paracentesis and did not afterward have a single perforation. However, the most careful attention will not always prevent trouble. One day you may find the patient doing well, and on the next the cornea may be perforated. It is well to remember that this is a very fatal form of eye disease.

"*Abstraction of blood by leeches* may also be practised. As a rule, however, this is not very frequently employed in young children. One leech may be used at about one inch from the external canthus, but frequently it should be removed before wholly filling, and the resulting hemorrhage may be stopped by pressure or styptics. Repetition of the leeching is rarely required; but the leech may be applied again in twenty-four hours if the hyperæmia return. A membrane sometimes forms on the conjunctiva of the lid or globe, or both, which may or may not be true diphtheritic conjunctivitis. It is an open question where membranous conjunctivitis ends, and diphtheritic conjunctivitis begins. In either event stimulating applications must be interdicted, at least until the membrane becomes thrown off. In other respects the treatment is similar to what has already been laid down. In Europe diphtheritic conjunctivitis is very fatal to the eye. In this country, for some reason not well known, it does not seem to be so fatal, although in a bad case here the eye is usually destroyed. When the eyes have nearly recovered from an acute attack, a chronic conjunctivitis may result, even passing into a granular conjunctivitis or a true trachoma, when stimulating applications to the lids may be used, including atropine drops as a collyrium if there should be any photophobia or corneal trouble. If the child be of good constitution, however, and the general health be carefully preserved, this latter sequel to the disease does not often occur."

CHAPTER XII.

DISEASES OF THE UMBILICUS.

When properly managed, the cord desiccates and falls off between the third and ninth days. The nurse should not be allowed to oil it, which she will sometimes do unless forbidden, as this retards desiccation. If the dressing of the cord be allowed to remain wet from the

urine or otherwise, it does not desiccate, but decomposes. This is not infrequent in poor, intemperate, and slovenly families. The decaying cord is apt to produce inflammation of the navel. Some Southern physicians, prior to the late war, attributed the prevalence of trismus neonatorum among the slaves to the lesion of the navel produced by this cause.

Thrombosis and Phlebitis of the Umbilical Vein, Septicæmia of the New-born.

When the cord is ligated at birth, a considerable part of the blood in the umbilical vein flows away and enters the systemic circulation, but that which remains forms small clots or thrombi. These clots contract and harden, becoming in time calcified, and remaining inert and harmless in the system, or they may soften and dissolve. The ductus arteriosus, as I have frequently noticed at autopsies, and probably also the ductus venosus, are likewise occluded by fibrinous plugs when at birth they no longer participate in the circulation. But, so far as known, thrombi forming in these central vessels of the fœtal circulation do no harm and have no pathological significance; whereas those in the umbilical vein sometimes entail serious consequences, and even death. The entrance of air into the umbilical vein from the umbilical fossa, carrying with it germs from an infected atmosphere, may afford explanation of the serious disease long known under the designation of umbilical phlebitis.

The remarks of Prof. Ziegler, of Tübingen, on the issues of thrombosis, will aid to an understanding of the nature of this disease. He states the fact that the history and behavior of thrombi differ in different instances. In some cases he says that "the fibrin is transformed into a dense mass, which may persist unchanged for a long time, and ultimately becomes calcified. It is thus that the chalky concretions called phleboliths are formed in the veins. The very common issue of thrombosis in softening is much less favorable. In simple or red softening the central parts of the thrombus are first of all changed into a grayish or reddish pulp, consisting of broken-down and shrunken red corpuscles, pigment granules, and colorless granular detritus. If the softening then extend to the surface layers, and if the blood current is still flowing over the thrombus, the products of disintegration may be carried into the general circulation. . . . The result is the formation of emboli. The most unfavorable issue of all is the *puriform or yellow softening* of the thrombus. In this case the thrombus is transformed into a dirty or reddish-yellow, fetid, pus-like cream or pulp. This contains a multitude of pus corpuscles, and a large proportion of a finely granular matter, which consists in part of fatty and albuminous detritus, and in part of micrococci. The latter frequently form groups or colonies, and are probably to be regarded as the exciting cause of the softening process. Such puriform thrombi act destructively on the surrounding tissues and set up inflammation. The intima of the vessel becomes turbid or opaque; and suppurative inflammation begins in the tunica media and tunica adventitia, extending to the tissue enclosing the

vessel. Soon the entire thickness of the vessel-wall is infiltrated, and takes on a dirty yellowish or grayish appearance; ultimately the tissues undergo putrid degeneration. If the puriform matters are carried by the blood current to distant spots, they there produce necrotic or putrefactive changes in the tissues, and set up suppurative inflammation."

Puriform or yellow softening of the thrombi in the umbilical vein, occurs in those cases of inflammation of this vessel, which are attended by symptoms indicating general septic poisoning. This disease is usually fatal in the new-born; it has long been known and described, but its pathology has been obscure. The concise and clear description of the yellow softening of thrombi, quoted above from the Tübingen professor, enables us to understand its nature. It will be observed that he considers the introduction of micrococci into the thrombus as the cause of the destructive changes which follow. It would seem an easy matter for micrococci to enter the umbilical vein from the umbilical fossa, and it is perhaps surprising, in view of the perviousness of this vessel, that this accident is not more frequent. The following were examples of inflammation of the umbilical vein, and of septic infection, resulting from the phlebitis:

Case 1.—In May, 1884, an infant died in the New York Infant Asylum, having the following history: It was born after a natural labor, and there was no evidence of septic infection in the mother. The cord dropped on the seventh day, and the resident physician stated that the umbilicus appeared raw, and a slight oozing of purulent liquid occurred from it, showing its perviousness. My attention was not called to the infant until near its death, when I learned from the nurse that it had been very fretful during the last week, and recently the abdomen had become so distended and hard, that the physician of the asylum had diagnosticated peritonitis. Pressure upon the abdomen seemed painful, and an examination of other parts gave a negative result. The rectal temperature at this time, within two days of its death, was 102.4°; the day before, it had been 100.6°. Death occurred on the morning of the fifteenth day.

The autopsy was made twenty-six hours after death, by Prof. W. H. Welch. Six ounces of turbid serum were removed from the abdomen, containing yellowish flakes of fibrin. In the vicinity of the umbilical vein, and upon the under surface of the liver, especially along its transverse fissure, the peritoneum was covered by fibrin; no marked congestion of peritoneum; a number of lymphatic vessels filled with pus could be seen under the peritoneal covering of the diaphragm, showing in what way septic infection extends along the lymphatics. The lymphatics of the diaphragm open upon the pleural surface, and it is probable, had the patient lived longer, that suppurative pleuritis would also have occurred. The umbilical vein was filled from the navel to the transverse fissure of the liver with a grayish softened detritus, consisting of broken-down thrombi, with a considerable proportion of pus. Softened thrombi could be traced the entire length of the umbilical vein, the walls of which were infiltrated and thickened from inflammation. No thrombi were seen in the portal vein or vena cava. Under the endocardial lining of the heart hemorrhagic points could be seen. The pericardial cavity contained more than the normal quantity of serum, with a few flakes of fibrin. The bronchi contained brownish mucus, and hemorrhagic spots were observed in the posterior portions of the lungs; no evidence of pneumonia; pan-

creas, suprarenal capsules, ovaries, and uterus normal; ecchymotic spots under the peritoneal covering of the kidneys, and under the mucous membrane of the calices.

It is probable that in this case septic micrococci played the important part in producing the many lesions, evidently of a septic nature, which were present. These organs entering the lymphatics, and perhaps carried along in the bloodvessels, find lodgement in various parts of the system, where they produce inflammatory or septic lesions, with, in most instances, a fatal result.

Case 2.—This infant at birth weighed eight pounds six ounces. It was plump and well developed, and the mother seemed healthy. When four or five days old it began to be feverish, one day the temperature rising to $104\frac{3}{5}^{\circ}$. The cord separated at the usual time and the umbilicus seemed healthy. At the age of two weeks an abscess appeared upon the scalp, one upon the back, and another upon the nates, indicating septic infection. These abscesses remained and new ones appeared as long as the child lived. At the age of four weeks orchitis on one side occurred, and continued for three weeks, when it abated. When the child was two months old a prominence appeared half an inch above the umbilicus, and when it had continued about one week, the resident physician punctured it, and bile instead of pus escaped. The opening closed soon afterwards, and, subsequently, a discharge of bile occurred from the umbilicus, which continued until death. The infant gradually wasted and became weaker, and finally died at the age of eight months.

Autopsy, by Prof. Welch. Infant much emaciated; its length twenty inches; the remains of old abscesses upon the trunk and extremities; an abscess on the right side of the occipital bone contained four drachms of pus, underneath which the occipital bone was carious over an area of one inch by half an inch. The dura mater below the carious bone was thickened, but the pia mater was normal. A probe passed from the umbilicus into and along the umbilical vein. The umbilicus seemed normal, except a small cicatrix at its site; heart normal; lower or depending portions of the lungs, the spleen, kidneys, suprarenal capsules, and bladder presented the appearance of passive congestion; stomach and intestines normal; tunica albuginea of the left testicle thickened. The umbilical vein was dilated to about twice its normal size, its walls were infiltrated and thickened, and it contained yellow thickened bile. One of the branches of the vein traced into the liver opened into an abscess about the size of a walnut, and containing thick pus, and through this abscess a communication had been established between the umbilical vein and the bile-ducts. The gall-bladder and the hepatic and cystic ducts contained bile and appeared normal; and the liver, except for the abscess, presented the normal appearance. The abscess was in the right lobe, near its posterior border, and it extended to the superior surface of the liver. The umbilical vein contained bile, with perhaps some bile-stained pus, but no blood; peritoneum, brain, spinal cord, and meninges normal.

Thrombosis of the umbilical vein, when the thrombi undergo putrefactive changes, is, as is seen by the above cases, one of the most severe and fatal maladies of the new-born. Disintegrating particles of fibrin loaded with micrococci may enter the circulation, and intercepted in distant organs cause embolisms. More disastrous still is the septic

infection of the system, such as occurred in the above cases, and which, as a rule, ends in death.

TREATMENT.—Little can be done to stay the fatal progress of the disease when putrefactive decomposition of the thrombi has occurred. We may endeavor to press from the vein into the umbilicus the particles of disintegrating fibrin, and perhaps we can in some instances inject into the vein a mild antiseptic liquid, as boracic acid in glycerine. But the results of such treatment would be uncertain and probably futile. Precautionary measures, especially antiseptic dressing of the umbilicus, as by dusting it with iodoform, might, if generally practised, diminish the number of these cases.

Inflammation and Ulceration of Umbilicus.

Inflammation of the umbilicus sometimes occurs in the new-born about the time of the detachment of the cord, or soon after. It probably results from uncleanliness, or carelessness in the management of the cord, by which irritating and decomposing substances remain in the umbilical fossa. Sometimes decomposing particles from the cord are the probable irritant. This disease is also most liable to occur in cachectic infants, or those of scrofulous parentage, whose general condition renders them liable to inflammations. The umbilicus becomes red, slightly swollen, and moist by a secretion. Often the inflammation remains two or three days in this mild form, receiving no treatment except from the nurse, and disappearing by the use of the dusting powder, as lycopodium, which she employs. In other instances, it extends over a radius of an inch or even more, the walls of the umbilicus become swollen and infiltrated, and ulceration succeeds. The ulcer is circular, occupying the site of the navel, and is attended by a purulent discharge. The inflammation may now gradually abate, and the ulcer heal with a cicatrix in place of the umbilicus. But in other instances, especially if there be decided cachexia, the ulcer extends in breadth and width, till finally, in the worst cases, the peritoneum becomes involved, and perforation or peritonitis occurs, with death.

Under unfavorable hygienic circumstances the blood of the infant being vitiated, the ulcer may become gangrenous, or the inflammation may terminate directly in mortification, without the formation of an ulcer. In either case the prognosis is unfavorable. If a dark brown slough occupy the site of the umbilicus, and a sero-sanguineous discharge exude from underneath, the common result is perforation, peritonitis, and death in from one to two weeks.

TREATMENT.—Inflammation of the umbilicus, if severe, and especially if attended by destruction of the tissues involved, rapidly reduces the strength. In such cases four or five drops of brandy should be administered every hour to two hours in the breast-milk.

In the simple inflammation the navel should be bathed with lukewarm water three or four times daily, and the ointment of the oxide of zinc be constantly applied; or if there be little or no discharge, the navel may be dusted with powdered bismuth. In case of ulceration the

navel should be gently washed three or four times daily with lukewarm water, to which carbolic acid is added—three or four drops to the ounce; and if there be much inflammation, a light poultice of pulverized slippery elm should be applied in the interval, or if the inflammation be moderate, the balsam of Peru. If gangrene supervene, the parts should be frequently bathed with carbolic acid water, and a cloth soaked with it applied over them, or iodoform should be constantly applied. The slough should be detached as soon as it is so far separated that its removal causes no hemorrhage, after which the treatment for ulceration is appropriate.

Umbilical Granulations or Fungus.

When the cord falls, granulations sometimes sprout out from the exposed raw surface, and complete cicatrization is impossible till they are removed. They form a rounded mass of pale reddish hue, at the centre of the umbilical fossa, bleeding when rubbed, and causing constant moisture of the umbilicus. The largest which I have seen had perhaps twice the size of a large pea, and they may be of any smaller size.

Treatment.—By pressing upon the umbilical parietes the tumor rises from the fossa, so that a silk ligature can be applied around its base, when the mass can be readily moved with the scissors. If the granulations be small, they may be removed by the scissors without the ligature, and hemorrhage prevented by touching the surface with lunar caustic.

CHAPTER XIII.

UMBILICAL HEMORRHAGE.

The granulations which have been described above occasionally cause considerable hemorrhage when injured. The profuse and even fatal hemorrhage which occurs at birth, or soon after, from too loose a ligature of the umbilical cord, or from laceration or other injury, is so well known, and its cause so apparent, that it need only be alluded to in this connection. Bouchut details a case in which death occurred even before birth, from this form of hemorrhage. The child was attached to the placenta by a very short cord, which prevented delivery till it parted by the traction of the forceps. The bleeding from the umbilical vessels was so profuse, that the child was pallid and lifeless when born.

There is another form of umbilical hemorrhage, cases of which have been from time to time observed for more than a century (one of the first on record was reported in the *Gentleman's Gazette*, April, 1752,

by Mr. Watts, a physician in Kent, England), but little was done to elucidate its nature till three American physicians made it the subject of careful study, and the monographs which they have published upon it are the best which the literature of the profession affords. Dr. Francis Minot read his paper, containing the statistics of 46 cases, before the Boston Society for Medical Improvement, in April, 1852. Prof. Stephen Smith prepared his paper, containing the statistics of 79 cases, for the New York Statistical Society, in 1855. It was published in the *New York Journal of Medicine* for that year. Dr. J. Foster Jenkins presented his monograph as a report to the United States Medical Association in 1858, and it was published in the *Transactions* of the Association for that year. This paper is very valuable on account of its statistics, as the writer succeeded in collecting the records of 178 cases from medical journals, and gentlemen of the Association. These three papers contain nearly all that is known in reference to this disease.

Sex—Age.—Females are less liable than males to this hemorrhage. In Jenkins's cases, 34¼ per cent. were females, 65¾ males. The following table gives the age at which the hemorrhage commenced in 99 cases:

Age.	Nos.
Under 1 day	5
Under 2 days	7
Under 3 "	6
Under 4 "	3
5 to 7 " (inclusive)	32
8 to 10 " "	25
11 to 15 " "	16
16 to 21 " "	4
56 "	1
	99

Ordinarily the bleeding commenced very soon after detachment of the cord, but in not a few the cord was still adherent.

Causes.—The common proximate cause is feeble coagulability of the blood. In the normal state, when the cord is ligated, the fibrin of the blood, which now ceases to flow in the umbilical vessels, forms coagula so firm that, by the time the cord is detached, hemorrhage is impossible. But in the majority of those affected with this disease, the clots are so soft and loose that they do not present any effectual barrier to the pressure of blood, which therefore oozes through them or presses them away. This lack of coagulability is easily demonstrated, for if a little blood, as it escapes, be caught in a vessel, it will be found to remain liquid a long time. This dyscrasia, or morbid state of the blood, which we therefore recognize as a chief cause of the hemorrhage, does not have the same origin in all cases. It is sometimes due to inherited syphilis. The infant affected with it may be plump, and appear well at birth, but in most instances, when the hemorrhage is to occur, it is puny and cachectic, exhibiting also local manifestations of the disease or cachexia from which it suffers. Thus, in a case in my practice, the infant, puny, and apparently born before term, was observed to have several blebs of

pemphigus on the first day, from some of which blood soon began to ooze, but the fatal umbilical hemorrhage did not commence till after two weeks.

In about one-fifth of the cases ecchymoses or petechiæ have been observed upon various parts of the surface, affording additional proof of the general blood disease.

Jaundice is another cause of impoverishment of the blood in the newborn, and therefore of umbilical hemorrhage. The writers who have collected records of the hemorrhage, all remark the frequent occurrence of the icteric hue, both before and during the bleeding. It is not improbable that, in certain instances, the jaundice is hæmatogenous, arising from destruction of the red corpuscles and liberation of the hæmatin, a not unusual result of a profound dyscrasia, whether syphilitic or originating from some other cause. But in other, and probably most instances, the jaundice proceeds from the liver, and is the cause of the change in the blood. Thus, in five of Jenkins's cases, there was occlusion of the hepatic or common bile-ducts, and jaundice, from the presence of biliary acids in the blood, causes diminution in the amount of fibrin and red corpuscles. In the ordinary form of icterus neonatorum, the cause of which some suppose to exist in the relative fulness of the capillaries and minute bile-ducts in the acini of the liver, destructive blood changes probably occur in proportion to the degree and duration of the jaundice, and hence the tendency to hemorrhage observed in some of these cases.

Poor health of the mother, and impoverishment of her blood during gestation, whether from chronic disease, as tuberculosis, or antihygienic conditions, also cause impoverishment and increase the fluidity of the blood of the child, and are therefore causes of the hemorrhage. The excessive use of diluent drinks or alkalies by the mother is believed by some to have a similar effect.

In certain cases the hemorrhage is due to an inherited hemorrhagic diathesis. In nine of Jenkins's cases the mothers were subject to menorrhagia, and liable to bleed freely after parturition, and from injuries; and seventeen other mothers had each lost more than one infant from umbilical hemorrhage. Probably in those cases in which the hemorrhage commences before detachment of the cord, and external to its point of insertion, the hemorrhagic diathesis is the main cause of the flow.

Although the cause of umbilical hemorrhage in the majority of cases is the vitiated state of the blood itself, observers, among others the late Sir James Y. Simpson, have met cases in which the hemorrhage was referable to the state of the vessels. In order that the vessels be effectually closed by the fibrinous coagula, their walls should have their normal contractility, but this is in great part lost by inflammation (arteritis or phlebitis) which sometimes occurs in these vessels, as we have already seen. Inflammation, whether of artery or vein, causes thickening and infiltration of its parietes, loss of tone on the part of the fibres of which they are composed, and therefore a patulous state of the vessel.

Symptoms.—Ordinarily umbilical hemorrhage occurs without any premonition, but sometimes it is preceded by jaundice. Jenkins ascer-

tained that jaundice was a prodromic symptom in 41 out of 178 cases, and besides the icteric hue, constipation, clay-colored stools, deeply tinged urine, etc., were sometimes recorded. Rarely colicky pains and vomiting preceded the hemorrhage. The blood may be arterial or venous, or both. It oozes slowly or rapidly, rarely escaping in a jet, even when there is reason to believe that it is arterial.

Prognosis.—This is unfavorable. Statistics show that five in every six perish. The prognosis is most unfavorable when jaundice or purpura hemorrhagica is present. Those are most likely to recover who have a healthy parentage, no obvious dyscrasia, and in whom the hemorrhage occurs late, and is not profuse. The average duration of the hemorrhage in 82 fatal cases in Jenkins's collection was three and a half days, the minimum being only three hours. After the arrest of the hemorrhage, death may occur from exhaustion or the dyscrasia.

Treatment.—The treatment should be both constitutional and local. It is important, so far as time will permit, to treat the dyscrasia, and as the stools are frequently constipated, a laxative is often indicated. A laxative is not only useful for its effect on the hepatic circulation, but as a derivative. Both Smith and Jenkins recommend calomel for this purpose. The modes of treating the bleeding parts have been various. Those most deserving of mention are the following: injecting a styptic into the open vessels, applying a styptic by compress or sponge to the navel, covering the navel with dry or wet plaster of Paris, constant pressure with the finger, which is tedious, but which maternal solicitude willingly provides, and lastly, the use of needles with ligature. All of these methods have been more or less successful in arresting the hemorrhage, but the last is most effectual, though painful. Two needles should be passed through the umbilicus at right angles, and a waxed thread wound around each in the form of the figure 8. In four or five days the needles should be removed, and a poultice or simple dressing applied.

CHAPTER XIV.

DIAGNOSIS OF INFANTILE DISEASES.

General Observations.

Diseases in early life differ in important particulars from those occurring in maturity. Some which are common in the former age are unknown or are rare in the latter, and those which occur equally at all ages often present peculiar symptoms and a peculiar clinical history in the young. Therefore physicians who are skilful in treating adults, may be unskilful in treating children. Excellence as a physician of

children can only be achieved by special and continued study of their ailments.

Again, as regards the disease of infancy, in which period there are a great amount of sickness and a large mortality, diagnosis must evidently be made from the objective symptoms; from examining the features, attitude, utterances, the pulse, respiration, etc., and inspecting the surfaces, so far as they are accessible to view, and the eliminated products. We lack for this age the important information which speech affords. Some general remarks, therefore, in reference to the appearances and functions of the system in early life, and the changes which they undergo in various pathological states, seem requisite, in order to a clearer appreciation of the symptoms, and more ready diagnosis of individual diseases.

Features, External Appearance of Head, Trunk, and Limbs in Disease.

In the new-born, as soon as respiration and the new circulation are established, the cutaneous capillaries become distended with blood, and the skin presents a congested appearance. By the close of the first week this external hyperæmia begins to abate, and is soon replaced by the normal capillary circulation.

Icterus is common in the first and second weeks. Bouchut attributes it to mild hepatitis. A much more plausible view of its causation, and probably the correct one, is that of Frerichs, who attributes it to the effect on the hepatic circulation of ligation of the umbilical cord. By ligation the current of blood through the umbilical vein to the liver ceases, the amount of blood in the hepatic capillaries, which connect with the branches of the vein, diminishes, and then, according to Frerichs, by the law of diffusion, diversion occurs of a part of the bile from the hepatic cells into the capillaries, while the rest flows in the normal manner into the bile-ducts. The degree of jaundice is proportionate to the amount of bile which enters the circulation. Icterus neonatorum is ordinarily not a disease of importance. If the general health remain good, it subsides without medicine in the course of one or two weeks, when the circulation through the liver becomes equalized and regular.

The surface, or portions of the surface, of the new-born often present for a few hours a livid color, due to the mode of delivery. Protracted lividity occurs from atelectasis or malformation in the heart or great vessels; lividity induced by exertion or excitement, while the respiration is normal, indicates malformation of the heart or vessels; temporary lividity sometimes occurs in severe acute diseases, especially those of the respiratory organs; lividity, whether temporary or permanent, is a sign of imperfect decarbonization of the blood.

The cheeks of children are congested in febrile and inflammatory diseases, except in a cachectic or prostrated state of the system. Transient circumscribed congestion of the face, ears, or forehead constitutes a reliable sign of cerebral disease. Strabismus occurring in connection

with febrile reaction, oscillation of iris, inequality of pupils, and drooping of upper eyelids, also denote cerebral disease. The pupils are contracted during sleep; evenly dilated in death.

Dilatation of the alæ nasi during inspiration, with contraction of the eyebrows and a countenance indicative of suffering, attends severe inflammation of the respiratory organs. Absence of tears during the act of crying shows a severe and probably fatal form of disease in infants over the age of four months.

Rapid wasting of the features, causing deep suborbital depressions, prominence and pointedness of the cheek-bones and chin, and hollowness of the cheeks, are signs of severe diarrhœal malady; the most striking examples of this sudden collapse of features are afforded by patients affected with cholera infantum. In severe cases of this disease the physiognomy, from a state of fulness and health, presents in a few hours such a wasted and senile appearance that the friends with difficulty recognize the features with which they are familiar. Muscular tonicity is also greatly impaired in this disease, that of the orbicular muscles of the lips and eyelids to such an extent that the mouth is open and the eyeballs exposed during sleep. Great emaciation occurring gradually, is a symptom of subacute or chronic disease of a grave character, often of tuberculosis or chronic entero-colitis.

Strabismus sometimes occurs in children who have no serious disease. It is then due to simple paralysis of one or more of the motor muscles of the eye. But when supervening upon other symptoms of a neuropathic character, it is a grave symptom, indicating organic disease of the encephalon, as effusion, meningitis, etc. A permanently downward direction of the axes of the eyes, with smallness of the face and great expansion of the cranium, is a sign of congenital hydrocephalus. The scalp in this disease is tense, bald, or sparingly covered with hair, the fontanelles and sutures open and enlarged, and the cranial bones yield to pressure. Great expansion of the cranium above the ears, while the frontal portion is not enlarged, or but slightly, denotes hypertrophy of the brain.

The appearance of the general cutaneous surface possesses much greater diagnostic value in the diseases of infancy and childhood than in those of adult life. The eruptive fevers so common in the young, and comparatively rare in the adult, reveal themselves to us in great part by the changes which they cause in the appearance of the integument. The peculiar color of the skin in constitutional syphilis, hereafter to be described, and which is more marked in infancy and early childhood than at any other age, is a diagnostic sign of great value in obscure cases. In the infant the cold stage of intermittent fever is manifested, not by muscular tremors, but by lividity, pallor, and the goose-skin appearance of the surface.

Bulbous enlargement of the fingers and incurvation of the nails are signs of cyanosis, and, therefore, of malformation at the centre of the circulatory apparatus, or of tuberculosis, or chronic pulmonary disease attended by malnutrition. Enlargement of the spongy portions of bones, causing prominences, softness, and bending of the bones, and consequent deformity of the limbs, patency of the fontanelles, a large

and square shape of the head from calcareous deposit external to the cranium, and delayed dentition, are among the signs of rachitis.

In early infancy the glands of the skin and mucous surfaces, or which connect by their orifices with these surfaces, are slightly developed. Therefore, sensible perspiration and lachrymation are rare under the age of three months. A thick Meibomian secretion of a puriform appearance collecting between the eyelids is an unfavorable prognostic sign; it indicates a state of great depression; it is observed most frequently in cerebral and intestinal maladies shortly before death. Passive congestion of the vessels of the conjunctiva sometimes occurs under the same circumstances, due to feebleness of the heart's action, and imperfect capillary circulation. It indicates the near approach of death.

Attitude—Movements—The Voice.

A sharp, piercing cry, head firmly retracted, flexure of the limbs with a degree of rigidity, abduction of the great toe, clonic or tonic spasm of the muscles, irregular movements of one or more limbs, with consciousness impaired, or with mental hallucinations, are symptoms of grave disease of the cerebro-spinal system. Irregular muscular movements partly controlled by the will, and occurring during full consciousness, are symptoms of chorea, a disease nearly always ending favorably in children, though incurable in the adult. Contraction of the eyebrows, turning of the eyes and face from light, avoidance of noises, as if painful, are signs of headache. Frequent carrying of the hand to the ear, and pressing with the ear against the breast of the mother or nurse, are symptoms of otalgia. Frequent carrying of the fingers to the mouth in connection with fretfulness or other symptoms of suffering, indicates stomatitis, gingivitis whether from difficult dentition or other causes, painful pharyngitis, or some obstructive disease of the larynx. Frequent rubbing or pressing the nose may be due to intestinal worms or intestinal irritation from other causes. It may be due to coryza or headache. Frequent forcible rubbing or striking the nose should lead to a careful examination and perhaps guarded prognosis. It often indicates grave cerebral disease, and may be a precursor of convulsions.

In severe obstructive disease of the larynx the child is restless, moving from side to side. In most inflammations of the respiratory organs, a semi-erect position gives most relief. The voice in severe laryngitis is often hoarse or indistinct, and is usually so in the pseudo-membranous form; in pleuritis or pneumonitis it is restrained and abrupt, since the movements of the walls of the chest give pain.

The voice in severe diseases of the abdominal organs is feeble and plaintive. It is sometimes short and restrained in acute dyspepsia, in peritonitis, and in cases of great abdominal distention. The horizontal position gives most relief in abdominal diseases. In case of abdominal pain the patient often presses his hand upon the abdomen and flexes his thigh over it. Perfect quietude, with features sunken, and unchanged by smile or crying, is a symptom of severe and exhausting diarrhœal affections.

Respiratory System.

The respiration of the infant under the age of six months is very irregular, and it is more irregular the nearer the time to birth. If the new-born infant be closely observed, it will be seen to sigh often; it breathes pretty uniformly and regularly for a moment, and then, without appreciable cause, the respiration is intermitted; it holds its breath when it smiles or moves its head, or even its limbs; it is very subject to hiccup; this is more common the first week of life than at any other age. So much is the breathing of the young infant disturbed by these causes, that the number of respirations ordinarily varies in consecutive minutes. In order, therefore, to determine with accuracy the frequency of the normal respiration for this time of life, it is necessary to take the average of several observations.

At birth, while the function of the heart has for months been regularly performed, the lungs are still quiescent. The one organ has been active during the greater part of fœtal development, the other is yet untried. Hereafter, in the new order of things, so intimate is the relation between the heart and lungs, that the proper performance of the function of the one is essential to that of the other. Therefore, the commencement of respiration and the return of circulation, which is modified and temporarily arrested at birth, are nearly simultaneous. Respiration begins in the first half-minute of independent existence; often, indeed, attempts to inspire occur before delivery is completed. The exceptions to this early establishment of respiration are after tedious or unnatural births. The establishment of the new circulation is a moment later.

Respiration in Health.—As the air-cells at birth are closed, the establishment of respiration is difficult. The air at first penetrates a few pulmonary cells, but gradually more and more are inflated through the forcible inspirations which the crying of the infant produces, till after a variable time, respiration becomes easy and complete. If the cry be feeble, and especially if with this feebleness there be considerable congestion of the brain, the result of tedious birth, the full establishment of respiration is in a corresponding degree gradual and slow.

The frequency of the respiration in health should be ascertained, in order to determine whether, in a given case, it be abnormally accelerated. The following table embodies the result of observations which I have made, in order to determine the normal frequency of respiration in the first year of life.

Normal Infantile Respiration (number per minute).

	Age.										
	First half hour.	From first half hour to close of first week.		From close of first week to close of first month.		From close of first month to close of third		Close of third to close of sixth month.		Close of sixth month to close of first year.	
		Awake.	Asleep.	Awake.	Asleep.	Awake.	Asleep	Awake.	Asleep.	Awake.	Asleep.
Number of observations	29	28	14	13	13	16	10	25	7	19	6
Extreme number of respirations per minute	25–104	32–64	40–64	40–96	28–60	32–68	28–52	36–88	24–40	28–64	24–36
Mean number of respirations per minute	48.5	52	52	59	45	51	39	54	33	41	29

As the child advances from the age of one year, the number of respirations per minute gradually diminishes; but through the whole period of childhood it remains greater than in the adult. At the age of five years, when the child is quiet, but awake, it is about 27; at the age of ten years, about 22.

Respiration in Disease.—In cerebral diseases the respiration becomes slow, and if somnolence occur, intermittent, and accompanied by sighing. In young infants, in the drowsiness which supervenes when the blood is imperfectly decarbonized, during severe attacks of capillary bronchitis, or broncho-pneumonia, respiration is likely to be intermittent.

In inflammatory diseases of the larynx and trachea, respiration is but slightly accelerated, and, if there be no obstruction, its rhythm is normal; if there be obstructive disease, its rhythm is altered; the inspiratory act is lengthened. In bronchitis, respiration is accelerated in proportion to the degree of extension downward of the inflammation. It is in no disease more accelerated than in severe capillary bronchitis.

In pleuritis and pneumonitis, the respiration is accelerated in proportion to the extent and acuteness of the inflammation. Inspiration ending abruptly, and succeeded by an expiratory moan, is a symptom of both pleuritis and pneumonitis in their acute stages. In certain cases of irritative or inflammatory disease of the abdominal organs, respiration presents a similar character; it is modified in this manner in consequence of the pain experienced in movements of the diaphragm. Ordinarily, however, in abdominal diseases, respiration is nearly natural.

The cough is an important diagnostic symptom. It is loud and sonorous in spasmodic croup, hoarse or harsh in true croup, clear and distinct in bronchitis, suppressed and painful in the early stages of pneumonitis and pleuritis, convulsive and with more inspirations than expirations in pertussis. A cough due to coexisting bronchitis is one of the first and most constant symptoms of measles. Typhoid and remittent fevers, difficult dentition, intestinal worms, irritating ingesta, and severe burns, sometimes give rise to a cough, which is nearly dry

and painless. Occurring in such diseases, it is sometimes dependent on more or less bronchitis, to which the primary disease has given rise.

A strongly marked nasal or palatal cry is present in syphilitic ozæna, hypertrophied tonsils, and paralysis of the soft palate. If these can be excluded, it indicates retropharyngeal abscess. On one occasion Pollitzer heard this cry in a baby that the mother said was well; but he introduced his finger in the fauces, felt the expected swelling, and, by an incision, evacuated a considerable amount of pus.

An excessively prolonged, loud-toned expiration, with normal inspiration, and without dyspnœa, is, according to Pollitzer, an early symptom of chorea, sometimes preceding all other symptoms. He was once called to a child, apparently well and asleep, in whom this symptom had continued two hours, and was supposed by the mother to indicate croup. Later the ordinary symptoms of chorea appeared. The same author regards a high thoracic, continued sighing inspiration as almost pathognomonic of weak heart, and of certain cases of acute, fatty heart. Unlike the condition in laryngeal stenosis, while the diaphragm is nearly inactive, the accessory muscles of inspiration act strongly. This symptom occurs early, before the lividity or pallor, or weak pulse, or cold extremities.

A distinct pause after each expiration, ascertained in a quiet room by placing the ear close to the mouth, distinguishes laryngeal catarrh from croup. (Pollitzer.) Stridulous inspiration usually indicates acute laryngeal catarrh, but I have, in a considerable number of instances, been asked to prescribe for infants with stridulous respiration, which commenced early, perhaps in the first or second month, and continued night and day till about the close of the first year, when, in the development of the child, it ceased. It is attended by no dyspnœa or suffering, does not interfere with the nutrition or growth, is not benefited by any known treatment; and it seems that it may exist within physiological limits.

A shrill, loud cry, night after night, in sleep, while the child is well in the daytime, is probably due to dreams, and it may be treated by a large dose of quinine at bedtime, but a full dose of the bromide of potassium or sodium is, perhaps, more apt to give relief. A cry, lasting five or ten minutes, and occurring several times in the day, indicates spasm of the bladder, especially if dysuria be present. It is best treated by belladonna, provided that there be no calculus. A cry, during defecation, indicates fissure of the anus, and is to be treated by an ointment of zinc and belladonna. A violent and protracted cry, with restlessness, pressing the head on the pillows or breast of the nurse, and frequent carrying of the finger to the ear, indicate otalgia.

Circulatory System.

In all ages and countries the pulse has been considered an important symptom, both in diagnosis and prognosis. It aids the practitioner in determining, approximately, not only the character but the gravity of diseases. It is somewhat remarkable, from the importance which is

attached to the pulse in medical practice, that its natural frequency and its character in infancy are not more accurately known. It is true that eminent observers, as Trousseau and Valleix, have published statistics relating to the infantile pulse in health, but these statistics disagree, and therefore do not afford a reliable standard with which to compare the pulse in disease. Moreover, some published statistics of the pulse possess but little value, from the small number of observations; some from the fact that records of the infantile pulse are grouped with those of older children; and others because the state of the infant, as regards its activity or emotions, is not mentioned.

PULSE IN HEALTH.—It is not easy to collect statistics of the pulse during the period of infancy, which are entirely free from error, since often slight derangements of the system in the infant frequently occur, which are not manifested by any marked symptoms, but which produce acceleration of pulse. In collecting the following statistics, sources of error, so far as possible, were avoided.

The movements of the heart commonly begin about one-eighth of a minute after birth. They are at first slow, the ventricular contractions not numbering more than eight or ten by the close of the first quarter minute. In the second quarter the cries are vigorous, and the pulse now is rapidly accelerated, rising commonly above 120, and sometimes above 160 beats per minute. In fifty-seven observations of the pulse in healthy infants during the first half hour of life, after the first quarter of a minute, I found that the extremes, with one exception, were 104 and 164—average, 139.

Table of Infantile Pulse in Health.

	Age.									
	First week.		From close of first week to close of first month.		From close of first month to close of third.		From close of third month to close of sixth.		From close of sixth month to close of first year.	
	Awake. Quiet; moving slightly; nursing	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.
No. of observations	22	16	10	10	15	17	25	6	20	3
Extremes	104–152	108–140	124–160	104–144	112–148	104–132	112–146	104–116	112–144	...
Mean	126	122	139	118	132	118	129	108	127	109

"M. Ledéberder," says Bouchut, "could only count the pulse in the first minute of life in six children, and he has observed from 72 to 94 pulsations." Valleix estimates the pulse, between the ages of two and twenty-one days, at 87. Trousseau states that the pulse, in the first week of life, varies from 78 to 150; and Dr. Gorham's observations are in the main similar to Trousseau's. My observations, as seen from the above table, do not correspond with the assertions of Ledéberder and Valleix. Indeed, if there were no conflicting testimony, there would

still be a strong presumption that these authors are in error, for we would not suppose that the pulse of the infant, in whom there is greater functional activity, both muscular and visceral, would fall so much below that of the fœtus. It is probable, from the expression, "could only count the pulse . . . . . in six children," that Ledéberder, and perhaps Valleix, counted the pulse in the wrist, which, with exceptional cases, is very difficult and often impossible in the first week of life, and that they missed some of the beats, or, not unlikely, sometimes counted their own pulse. Immediately after birth there is so little force of the ventricular systole, and the extreme arteries, therefore, of the system pulsate so feebly, that neither in the limbs nor at the anterior fontanelle can the frequency of the pulse be readily ascertained. It can be readily and accurately ascertained only by auscultation, or by placing the hand on the precordial region, or directly after birth by the pulsations in the umbilical cord.

The average pulse of the healthy infant in the first and second months is, according to Trousseau, 137 per minute, 128 from the third to the sixth month, and 120 from the sixth to the twelfth month. It is seen that his observations agree closely with mine, as regards infants who are quiet, but awake. One point of interest, established by the above statistics, is the great diminution in the frequency of the pulse in sleep.

Pulse during or after Active Movements or Great Mental Excitement.

	Age.				
	First week.	Close of first week to close to first month.	Close of first to close of third month.	Close of third to close of sixth month.	Close of sixth month to close of first year.
	140	162	176	132	132
	160	156	152	148	144
	140	140	158	148	152
	152	152	144	144	182
	...	...	152	156	198
	...	...	180	156	160
Extremes .	140–160	146–162	144–180	132–156	132–198
Mean .	148	152	160	147	156

It is seen, by the above table, that by active exercise, or great mental excitement, the pulse may become as rapid as in grave diseases. There is greater acceleration of pulse from the emotions and from exercise in feeble than in robust children. Obviously, in order to determine to what extent the pulse is accelerated in disease, it is necessary that it should be counted during a state of quietude. As the age increases, it is less and less influenced by the emotions and physical exertion; still, during the whole period of childhood, such influences do have more or less effect on its frequency.

Pulse in Disease.—Febrile and inflammatory diseases produce greater acceleration of pulse in early life than in maturity. Diseases, or derangements of system, particularly those of the digestive organs,

which do not materially affect the pulse in the adult, often cause acceleration of it in children. The febrile pulse of early life usually has exacerbations in its frequency. These commonly occur in the latter part of the day. Distinct and more or less regular febrile exacerbations and remissions are common in several diseases of early life, some of which are serious, while others involve little danger. Among these diseases may be mentioned difficult dentition, intestinal worms, incipient meningitis, and constipation. An intermittent and irregular pulse is common in fully developed meningitis and certain other severe organic diseases of the encephalon. It may be due also to disease of the heart, and it also occurs in some children from temporary disturbance of the digestive function. The pulse is slow in compression of the brain, and in sclerema of the new-born.

Animal Heat.

The internal temperature of the body in health is uniform. In 33 infants under the age of seven days, M. Roger found the average temperature 98.6° Fahr., while in 25, from four months to fourteen years old, it was 99°. The external temperature alone varies in health, according to the temperature of the atmosphere.

Elevation of temperature above the normal standard is a sign of inflammatory and febrile diseases. The increase of heat varies according to the nature of the disease and its type. In favorable cases of inflammation and in simple fevers it is not ordinarily more than two or three degrees. The greater the severity and malignancy of inflammatory and febrile diseases, the greater the elevation. An elevation of more than six degrees indicates a malady which is likely to prove fatal. It is rare that the temperature, even in fatal cases, rises above 107°. In measles, in the eruptive stage it is from 101° to 103°; in scarlatina from 102° to 104°, if no complication exist. In diphtheria the temperature is elevated at first, but it frequently falls to nearly the normal during the stage of profound toxæmia.

Reduction of the internal temperature is an unfavorable prognostic sign; it is observed, a few hours before death, in infants who are greatly reduced by certain chronic diseases, as entero-colitis. In these cases the tongue and even sometimes the breath communicate to the finger or hand a sensation of coldness.

The importance of thermometric observations, as an aid to the diagnosis of children's diseases, is within a few years more fully recognized by the profession. Two diseases which, in their commencement, present very similar symptoms, often vary as regards the temperature. Thus, meningitis, presenting in its first stages symptoms very similar to those of typhoid fever, has a lower temperature till an advanced stage, when the amount of heat increases.

Digestive System.

Inspection of the buccal and faucial surfaces discloses some of the most frequent local diseases of infancy, as the various forms of stomatitis, and others which, though not frequent, involve great danger, as gangrene of the mouth, diphtheria, and retro-pharyngeal abscess. Inspection of the tongue aids in determining in many cases whether the disease be pursuing a favorable course, or has become asthenic, and is exhausting the vital powers.

Febrile movements, even when slight, give rise to coating of the tongue, and intumescence and distinctness of its follicles. The eruptive fevers are attended by changes upon the buccal and faucial surfaces which possess diagnostic and prognostic value. Hyperæmia of these surfaces appears early in rubeola and scarlatina, prior to those phenomena which are justly regarded as pathognomonic. It is, therefore, often an important sign in the initial period of these diseases when the diagnosis is obscure. The appearance of the fauces in diphtheria and croup, indicating not only the nature of the disease, but its gravity, need only be referred to in this connection.

Inspection of the buccal and faucial surfaces sometimes enables us to form a probable opinion in reference to the nature of diseases which are seated in other parts. In the infant protracted stomatitis is a common accompaniment of chronic diarrhœa, and it indicates its inflammatory nature.

Vomiting is more frequent in infancy than in childhood, and in either period than in adult life. It is common in cerebral affections, and is one of the first symptoms of scarlet fever, and is not uncommon though less frequent, in the commencement of the other essential fevers and of acute inflammations. It is a symptom of indigestion, entero-colitis, cholera infantum, and intussusception; it is common, also, after the paroxysmal cough of pertussis, and not infrequent in the bronchial inflammations of young infants. In both these diseases it is excited by the muco-purulent matter upon the faucial surface.

Intestinal gas is in part secreted or exhaled from the mucous membrane, as the experiments of Hunter and others have shown, and is in part the product of chemical changes in the food. A certain amount of gas in the intestines is normal; it subserves a useful purpose. An abnormal amount of it is common in various diseases, as indigestion, chronic entero-colitis, peritonitis, typhoid fever. It is a frequent cause of gastralgia and enteralgia in the infant. In scrofulous or feeble infants, with impaired muscular tonicity and faulty digestion, the abdomen is often habitually more or less distended with gas, which does not, under such circumstances, give rise to pain or other local symptoms; it has significance as showing the general condition of the child.

In the rachitic, whose thorax is compressed and liver often enlarged, while the vertebral column is shortened, the abdomen is commonly protuberant. In feeble children, not decidedly rachitic, whose lungs are seldom fully inflated, and whose chests are consequently depressed, the abdomen is also prominent. The accompanying woodcut represents

one of these cases, presented for treatment at the outdoor department at Bellevue.

In feeble children who have suffered from repeated and protracted attacks of bronchitis, and whose chest walls are consequently depressed, a similar abdominal prominence occurs.

Retraction of the abdominal walls is common in meningitis, and in many exhausting diseases. Tenesmus is a symptom of intussusception in the infant, and of colitis in children.

Fig. 5.

Much light is thrown on the character of intestinal diseases by the appearance of the stools. Muco-sanguineous stools accompanied by fever, are a sign of colitis. Stools containing unmixed blood, and not accompanied by fever, may result from a rectal polypus, and from purpura hemorrhagica. Scanty evacuations of blood, with obstinate constipation, are a symptom of intussusception in infants.

The alvine discharges of infants often present a green color; sometimes they have the normal yellow hue when passed from the bowels, but become green on exposure to the air, or from reaction of the urine. By the microscope the green coloring matter is seen to occur in small, irregular masses. This green substance has been supposed to be bile. I am convinced that, as it occurs in the stools of the infant, it is commonly produced by the action of the intestinal secretions on the contents of the intestines; for I have often noticed that the contents in and above the jejunum were yellow, while in and below the ileum their color was green. Probably the green color is due to the formation of biliverdin from the bile which is mixed with the fecal matter.

The green hue may occur from very different causes. It may be due to over-feeding, to the action of cold, to irritating ingesta, to inflammation, etc.; it may be transient, subsiding within a day or two, or it may continue several days. All infants, at times, have green evacuations, even when they appear in good health.

In the commencement of a large proportion of diarrhœal maladies in infancy the stools give an acid reaction with litmus-paper. This acid, if in considerable quantity, is irritating, increasing the peristaltic movements of the intestines, and the functional activity of the intestinal follicles, causing erythema of the skin around the anus, and reacting upon and intensifying the intestinal disease. Hence the indication for the use of antacids in the diarrhœal affections of infancy.

The presence of intestinal worms and the species may be ascertained by microscopic examination of the stools of the child who is affected with these entozoa. The stools contain ova, which differ in size and shape according to the species of worm.

Nervous System.

Pain.—This symptom affords important aid to the physician in determining the seat and nature of the diseases of children. Pain in the head may occur in them from coryza involving the frontal sinuses, or from febrile movement in the commencement of an essential fever, or of inflammation of one of the organs of the trunk. Produced by such a cause, it abates in two or three days. If it be protracted, whether constant or intermittent, it is in many cases not neuralgic, as it so often is in the adult, but is due to organic disease of the brain or meninges. Complaint, therefore, of headache in a child, without any apparent general cause or local cause external to the cranium, should awaken solicitude, and, if it be protracted, the physician should examine carefully in reference to the presence of a cerebral or meningeal disease. Mild frontal headache, continuing for weeks or months, is neuralgic and due to anæmia. It is increased by pressure over the occiput and upper cervical vertebræ.

Grave thoracic or abdominal inflammations in the adult are almost always attended by a corresponding amount of pain and tenderness; but in children these symptoms are often absent, or, when present, are frequently not commensurate with the amount of disease. Thus, enterocolitis of nursing infants is, in a large proportion of instances, almost free from these symptoms.

Pain in the chest or abdomen, occasional or constant, continuing for weeks or months, with fever, and unattended by thoracic or abdominal disease, indicates caries of the vertebræ. Its most common seat is the epigastric, umbilical, or hypochondriac region. It is a neuralgia due to irritation of the sensitive root of one or more of the spinal nerves. It is a very important symptom to the diagnostician, showing the nature of the disease, which in its incipiency is so obscure. Pain in the leg, especially the inside of the knee, is of a similar character, indicating disease of the hip-joint.

Children with certain acute febrile and inflammatory diseases sometimes have hyperæsthesia of portions of the surface; it is especially marked upon the anterior aspect of the trunk. The physician might be misled into the belief that the tenderness occurred over the seat of the disease and indicated an inflammation; but the pain of hyperæsthesia can be diagnosticated from that of inflammation by the fact that it is so extensive, is less on firm than light pressure, and is especially observed upon the inner surface of the thighs. The symptoms pertaining to the nervous system occurring in the various diseases treated of in this book will be fully described in connection with those diseases, and, therefore, need not detain us in this connection.

CHAPTER XV.

THERAPEUTICS.

THE young practitioner is often perplexed in deciding exactly what dose of the stronger and more dangerous medicinal agents to prescribe for a child. A practical rule, which holds good for many medicines, has been proposed by Dr. Cowling, as follows: "The proportional dose for any age under adult life is represented by the number of the following birthday divided by twenty-four." This rule is inadmissible for infants under the age of six months, but will apply for those that are older, for the use of a large number of medicines. Another rule proposed by another British physician, Professor Clarke, is based on differences in weight of children and adults: The adult dose is represented by 150. The dose of a child is determined by dividing its weight in pounds by 150. But it is an interesting fact, and one of practical importance, that children bear and often require, in order to obtain the desired effect, a much larger proportionate dose of certain agents than adults. This is partly attributable to the active elimination in childhood. Belladonna is notably one of the agents which children tolerate; and it may be added that some children can take a much larger dose of it than others, without producing the physiological effects. Thus, recently, I increased gradually the tincture of belladonna to twelve drops for a child of four years, without producing the usual efflorescence; and Farquharson says "the dose . . . I have pushed in a child of ten, suffering from incontinence of urine, to f℥ij (British Pharmacop.) with good effect, and the development of mild forms of physiological disturbance." Arsenic is also better tolerated by children than adults. An infant of six months can take two-drop doses of Fowler's solution three times daily without ill-effect. Prussic acid, strychnia, iron, ipecacuanha, and alcohol, are also required in larger proportionate doses in childhood than is indicated by the rule either of Dr. Cowling or Professor Clarke.

When practicable, medicines should be given in the liquid form. Those not soluble may often be given in suspension, in some vehicle which in great part disguises the taste. A good vehicle for the bitter vegetables, as the salts of quinia, is the elixir adjuvans of Caswell and Hazard. The following is the formula for its preparation:

℞.—Cort. aurant.	ʒij.
Pulv. semin. coriandr.	
Pulv. semin. carui	āā ʒj.
Pulv. cort. pruni Virginianæ	ʒiv.
Pulv. rad. glycyrrhizæ	ʒvj.—Misce.
Menstruum, Alcohol	partis j.
Aquæ	part. ijss.—Misce.
Percolat. O. v, et adde—	
Syr. simplic.	
Aquæ	āā Oijss.

The elixir adjuvans may also be advantageously employed in the administration of many other medicines apart from those which are repulsive on account of their bitterness. It holds them in suspension so that if they have a greater specific gravity than the elixir it is necessary to shake the bottle thoroughly before using it. The elixir taraxaci comp. is another good vehicle for bitter vegetables, although, like the elixir adjuvans, not officinal. I am sure from many observations, that unpleasant doses are apt to be wasted to a greater or less extent, and the repugnance of children to medicines employed has induced many a parent to seek other and less disagreeable modes of treatment. Chemistry has greatly aided the therapeutics of childhood, in that it has enabled us, in so many instances, to prescribe the active principles in place of the large, nauseous doses formerly employed.

PART II.

CONSTITUTIONAL DISEASES.

SECTION I.

DIATHETIC DISEASES.

CHAPTER I.

RACHITIS.

Rachitis, or rickets, is regarded as a constitutional disease, though the symptoms and lesions which characterize it pertain chiefly to one of the systems. It occurs in the first years of life, and, therefore, during the period of most active growth of the skeleton. It is manifested by an abnormal nutrition and changed physiological action of the bone-producing tissues, namely, the epiphyseal cartilage and the periosteum, and by the arrest, more or less complete, of the deposition of lime-salts in these tissues.

Frequency of Rachitis.

Rachitis is a common result of faulty diet and of antihygienic conditions, and is, therefore, frequent among the poor of cities, and especially in families who dwell in crowded tenement houses. It has, heretofore, been prevalent in the city infantile asylums, but of late years, as regards at least the city of New York, it is much less common, in consequence of the greater attention now given to sanitary requirements in the management of these institutions. Mild cases of rickets are often overlooked, since physicians may not be summoned to attend them, while even if they be summoned, many, who have not given particular attention to this disease, are apt to err in diagnosis, and to refer the symptoms to some other than the true cause. Commencing gradually and insidiously, rachitis not infrequently continues for months, even in its typical form, before a correct diagnosis is made. In the absence of deformity, which is a late symptom, the fretfulness, tenderness of surface, and perspirations, receive a wrong explanation. Prac-

titioners who have heretofore given little attention to this malady, and who believe it to be rare, if they are instructed in reference to its characteristic signs, and look for them in their visits among the city poor, are surprised at the number of cases with which they meet. A few years since, in the New York Infant Asylum, my attention was directed to a rachitic child, whose head had so changed from the normal shape, that the nurses, as well as the physician, had remarked the difference. Prompted by the occurrence of this case, which had gradually developed under my eyes, I made a careful examination of all the infants, and discovered, what I had not previously suspected, that about one in nine had become rachitic. In most of the infants the disease was mild, but with symptoms so characteristic that it was readily recognized. By effecting certain improvements in the diet, among which was the daily allowance of beef-tea to the older infants, rachitis, unless of a mild type, has since been rare in this institution.

The late Dr. John S. Parry, of Philadelphia, stated that at least twenty-eight per cent. of all the children, between the ages of one month and five years, who came under his observation in the Philadelphia Hospital during the three years preceding the publication of his paper, in 1872, were rachitic. This is certainly a larger proportion of those who present indubitably rachitic symptoms than occurs in any of the three New York institutions for children with which I have an official connection. In the New York Foundling Asylum, with its sixteen hundred inmates, and in the Bureau for the Relief of the Out-door Poor, where over eight thousand children are annually treated, rachitis is certainly less frequent than is indicated by the statistics of Dr. Parry. In Europe, from the testimony of many observers, both continental and British, rickets is very common among the families who seek medical advice in the institutions of charity. Ritter von Rittershain finds that thirty-one per cent. of all the children who are brought to the Prague Medical "Poliklinik," are rachitic, and Prof. Henoch states that the proportion is equally large in the families of Berlin, who are in similar reduced circumstances. According to Dr. Gee, whose statement was, however, made as far back as 1867–68, of the patients under the age of two years, in the London Hospital for Sick Children, 30.3 per cent. are rachitic. Both Dr. Hillier and Sir Wm. Jenner not only allude to the frequency of rachitis, but state that it is the cause of many deaths in London families. It appears, therefore, that this malady, though not rare in American cities where ill-fed and ill-housed families congregate, is less prevalent than in families similarly situated in Europe. The greater immunity in this country must be due to other causes besides difference in nationality, for the poor of American cities are largely of foreign birth.

But rachitis does not occur exclusively among the poor. Children of well-to-do families are also liable to it, provided that the conditions soon to be enumerated are present. Ignorance or disregard of the hygienic requirements of young children, and especially the use of improper diet, leads to the development of rachitis in wealthy as well as in destitute families. Merei, in his treatise on the *Disorders of Infantile Development* (London, 1855), states that in Manchester,

where his observations were made, one child in every five, in families in comfortable circumstances, presented rachitic symptoms; and he believes that this cannot be much above the real proportion in "the whole of the wealthy classes."

Rachitis, in its milder form, is not uncommon in affluent families in this country, the cause of the delayed dentition, the fretfulness, and perspiration, not being suspected in many instances, as I have had opportunities to observe. Often family physicians are not consulted in reference to such symptoms, and when they are called in, so little attention has rachitis received on the part of many practitioners, that they are very apt to overlook the true pathological state which is present. Still, admitting the fact that many cases are not diagnosticated, I repeat that, though rachitis is not uncommon on this side of the Atlantic, its percentage of frequency falls below that observed in European cities, a fact which may be due to less crowding in their domiciles, and to a more liberal and better supply of food among the families of the poor in this country.

Age at which Rachitis Occurs.

Rachitis is, with few exceptions, a disease of infancy, commencing prior to the age of two and a half years. Now and then, it, or a state closely resembling it, occurs in the fortus, causing deformities, such as are present in typical cases. In the Kinderspital Museum, at Prague, is a specimen showing this, and described by Ritter. Hink and Winkler also describe such cases, and Virchow alludes to a specimen in the Wurzburg Museum, which exhibits such deformities as characterize rachitis. Bednar even regards fœtal rachitis as not uncommon (Hillier, Parry). In the Wood Museum of Bellevue Hospital, is a skeleton which is probably similar to those in the Prague and Wurzburg Museums. It shows in a striking manner the deformities of this congenital disease. The case occurred in my practice, and the dissection was made by Prof. Francis Delafield. The infant, born at term, died a few hours after birth from atelectasis, apparently produced by the contracted state of the thoracic walls. The parents were hard-working English people, whose mode of life and surroundings were such as are known to conduce to rachitis. They were free from syphilitic taint. The accompanying woodcut (Fig. 6) represents this skeleton.

Fig. 6.

Skeleton of a rachitic infant which died a few hours after birth.

The following remarkable case of supposed fœtal rachitis was related to me by Heitzmann, whose interesting experiments will be presently detailed:

Case 1.—A woman who had frequently inhaled the vapor of lactic acid each day, for many months, as she was employed to feed animals

with this agent, gave birth to an infant, at term, which died immediately after it was born. It exhibited the signs of congenital rachitis in a high degree. The skull bones were completely absent; in the cartilages of the bones of the extremities, and in those of the ribs, there were scanty depositions of lime-salts, and numerous infractions. The death of the child was evidently due to the absence of the skull bones, inasmuch as the pressure of the womb during delivery had caused cerebral hemorrhage. All the organs of the chest and abdomen were found in full development and healthy.

We will see, hereafter, that the theory which attributes rachitis, in certain instances, to a chemical irritant, is substantiated by experiment, and that it has already been shown that two such agents, phosphorus and lactic acid, may cause this disease. Now, as the irritating action of phosphorus on the osseous system occurs when it is inhaled in the form of vapor, as well as when received in the ingesta, so lactic acid, if the above case be rightly interpreted, produces its special effect upon the bone-producing tissues when inhaled, as decidedly as when received in the ingesta or generated in the system. These remarks seem necessary for an understanding of this unusual case, although they anticipate what will be said under the head of etiology. In the *New York Journal of Obstetrics* for November, 1870, Prof. Abraham Jacobi also published the description of a case of congenital rachitic craniotabes. Whether or not we accept as genuine all the reported cases of fœtal rachitis, there can be little doubt, from the number of observations already made and carefully recorded, and from the opinion of high authorities like Virchow, that such cases do occur.

Enlargement of the costo-chondral articulations known as the "rachitic rosary," which is one of the earliest and most reliable signs of rickets, has been observed, though rarely, in infants only a few weeks old. Dr. Parry saw it as early as the sixth week after birth,[1] and Dr. Gee at the third or fourth week.[2] This should not, however, be regarded as a sign of rachitis, unless the enlargement be so great that it can be readily appreciated by examination through the integument, or by sight, for in young children, with the bones in the process of normal development, these joints usually have a diameter a little larger than that of the ribs. Rachitis, with few exceptions, begins within the first eighteen months of life. Though first detected and diagnosticated at a later date, it will ordinarily be ascertained, on inquiry, that its symptoms had an earlier beginning. Still, according to certain observers, it may have a considerably later commencement. Glisson, Portal, and Tripier state that they have seen it commence in children who were well on toward the age of puberty. Sir Wm. Jenner states that he has seen children of seven and eight years, who were only beginning to suffer from rachitis.[3]

The following are the aggregate statistics of Bruennische, von Rittershain, and Ritsche, relating to the age at which rachitis occurs:

[1] American Journal of the Medical Sciences, January, 1872.
[2] St. Bartholomew's Hospital Reports, vol. iv.
[3] Lancet, December 11, 1880.

	No. of Cases.
During the first half year,	99
" " second half of first year,	259
" " " year,	342
" " third year,	134
" " fourth year,	31
" " fifth year,	17
Between the fifth and ninth years,	21
Aggregate,	903

Causes of Rachitis.

INHERITANCE.—In some infants there is an undoubted hereditary predisposition to rachitis. Feeble digestion and defective assimilation in the infant, which are, as we shall see, important factors in producing the rachitic state, are often traceable to disease or cachexia of one or both parents. The offspring of a tubercular, syphilitic, or otherwise enfeebled parent, is more likely to become rachitic than those of healthy and robust ancestry; and it appears that disease of the mother is more apt to entail a rachitic predisposition than that of the father. Among the parental causes may be mentioned poverty, hardships, and defective nutrition of either parent; age of the father, and exhausting discharges of the mother, such as purulent, hemorrhoidal, or uterine fluxes.

FOOD.—Of the exciting causes, the most common is the use of food not sufficiently nutritive, or, if nutritious, not suited to the age and digestive powers of the child. Thin and poor breast-milk, and artificial food of poor quality, or not suitable for the stage of growth and development, are common causes of rickets. Those children who have been prematurely weaned, and who have been given a food which is not a proper substitute for the natural aliment, and those too long wet-nursed and not allowed the additional nutriment which they require, are especially liable to this disease. Those whose digestive power is feeble, from whatever cause, are more apt to become rachitic than those who, in a state of robust health, have a hearty digestion. Hence we meet with rickets as a sequel of various protracted and exhausting maladies during infancy.

It might be supposed, from the nature of rachitis, that the use of food deficient in phosphoric acid and lime is the common cause of rachitis; but facts show that this is not the correct view of its etiology, as it commonly occurs, although in its treatment these agents are of undoubted value. The disturbed and altered nutrition of the osteoplastic tissues, namely of the epiphyseal cartilage and the periosteum, is the important factor in producing the rachitic bone disease, and this may occur although the ingesta contain a sufficient amount of phosphoric acid and lime. Deficiency of these substances probably tends to diminish the amount of lime deposition, but it is not the essential element in the causation of the malady. This is to be found in the unhealthy condition and action of the cartilage and periosteum, or rather in the agencies, now partly ascertained, which produce the abnormal state and altered nutrition of these tissues.

Artificial Production of Rachitis.

The important fact has been ascertained by experiments on young animals, that rachitis can be produced, as I have already stated, by at least two chemical agents, which may be admitted into the system in the ingesta, and which exert an especially irritating action on the osteoplastic tissues. Senator states, in Ziemssen's *Encyclopædia*, that "Wegner . . . has recently brought experimental evidence to show that true rickets may be artificially produced by the continued administration of very minute doses of phosphorus . . . together with a simultaneous withdrawal of lime from the food." The fact being established that it is possible to produce rickets by certain deleterious principles in the ingesta, opens an interesting field for experimental inquiry. Since improper feeding and indigestion are known to sustain a causative relation to rachitis, experiments have been made to ascertain whether some chemical agent, developed in the system during the digestive process, or introduced with the food, may not cause rachitis as it ordinarily occurs in the infant. Among the foremost in that line of experiment has been Dr. Heitzmann, a resident of Vienna when his observations were made, but now a citizen of New York.

In young children, acids, especially the lactic, are commonly produced, and often in large quantities, as the result of improper feeding, of indigestion, and of intestinal catarrh. The acidity of the infant's stools, under such conditions of ill-health, is well known. What more natural, then, than the supposition or belief that this acid, thus generated, sustains the same causative relation to rickets, as phosphorus in the experiments which have been made with that agent. But the acid which is produced so abundantly in disturbed states of the digestive apparatus in the infant, believed to be chiefly the lactic, must, in order to reach the bones and influence their nutrition, pass through the blood, which is always alkaline. This difficulty in the way of the theory that lactic acid is the irritating agent, is removed by physiologists, who tell us that among the organic acids the existence of lactic acid in healthy blood is not entirely beyond doubt, but that it has been found in the latter under abnormal conditions.[1] Lactic acid has also been found, after having made the circuit of the system, in the excretion from the kidneys.

Heitzmann, in order to ascertain whether this acid sustained a causative relation to rickets, made a series of experiments, which have passed into the literature of this disease, and he has kindly furnished me with their details, as follows:

"Marchand, Ragsky, Lehman, Simon, and others have found free lactic acid in the urine of persons suffering from rickets and osteomalacia. C. Schmidt discovered lactic acid in the liquid of malacic shaft-bones which were transformed into globular cysts. Encouraged by these chemical researches, I undertook a series of experiments on the action of lactic acid, administered both by the mouth and by sub-

[1] Heinrich Frey, of Zurich.

cutaneous injection, upon the bones of living animals, which experiments were begun in April, 1872, and continued until the end of October, 1873. The experiments were made upon five dogs, seven cats, two rabbits, and one squirrel. On dogs and cats under one year of age, the lactic acid, given either by mouth or injection, in combination with restricted administration of calcareous food, produced swelling of the epiphyses of the shaft-bones and of the anterior ends of the ribs, at their attachments to the costal cartilages. This result was plain in the second week after the beginning of the lactic acid treatment. Up to the fourth and fifth weeks, the swelling of the epiphyses and of the ends of the ribs kept increasing, and then was accompanied by curvatures of the bones of the extremities. As accompanying symptoms, I noticed catarrhal inflammation of the conjunctiva, of the mucosa of the bronchi, the stomach, and the intestines, with emaciation and convulsive movements of the extremities. The microscopic examination of the epiphyses gave an image fully identical with that of the epiphyses of rickety children. Upon continuing the administration of the lactic acid, the swelling of the epiphyses of the shaft-bones gradually increased, and so did the curvatures of the same bones. After four or five months of lactic acid treatment, under often repeated catarrhal inflammations of the above-named mucous layers, the shaft-bones became soft to such a degree that they could be bent like the branches of a willow-tree. After from four to eleven months of the same treatment, the microscopic examination of the bones gave a result corresponding with that obtained from the bones of women who have died with osteomalacia.

"On the three herbivorous animals no swelling of the epiphyses was noticeable. One rabbit died three months and the other five months after the commencement of administration of the lactic acid, but with symptoms of inanition. No marked evidences of rachitis or malacia were traceable in the bones of these animals. The squirrel, on the contrary, which died after thirteen months of treatment with lactic acid, gave all the features of osteomalacia.

"*My experiments give the result that by continuous administration of lactic acid, at first rickets, and afterwards osteomalacia, can be artificially produced in flesh-eaters; while in herbivorous animals, osteomalacia sets in without preceding symptoms of rickets.* Through these experiments I have proved the identity in nature of these two diseases, the differences in their course being due to the difference in the age at which the solution of the lime-salts is established. . . . Rickets can be produced on dogs and cats only under the age of ten or twelve months. Mr. Hess fed with lactic acid a dog of the age of one and a half years, and failed to produce rickets. This result is in full agreement with my experiments. I maintain that lactic acid, though not free in the blood, if in contact with the tissues producing bone, or with fully developed bone, owing to its great affinity for lime, either prevents the formation of bone (rickets), or dissolves ready-made bone (osteomalacia)."

On the other hand, rachitis sometimes occurs in infants who present no history of indigestion or of intestinal catarrh, and in whom there is no ground for the belief that lactic or any other acid is produced in

undue or injurious quantity. In a considerable proportion of such cases, inquiry elicits the fact of antihygienic conditions, but there is no evidence of imperfect digestion, or of gastro-intestinal catarrh, such as produces lactic acid. In the cases occurring in the New York Infant Asylum, alluded to above, some of the children had manifest gastro-intestinal derangement; but others, who were wet-nursed, gave no evidence of faulty digestion, though the nutriment which they received was probably insufficient; for, as already stated, by providing a more liberal diet, by allowing among other articles the juice of meat, rachitis became much less frequent, and is seldom observed at present among the infants of that institution, unless in a very mild form.

Virchow and others have suggested that the prime factor in causing rachitis is the use of a diet that is deficient in calcareous salts, and we have seen that in the interesting experiments of Dr. Heitzmann, the administration of calcareous food to the animals was restricted. Still, as Niemeyer has well said, deprivation or restricted use of the chalky salts cannot possibly cause the most important histological change in rachitis, namely, the proliferation of the epiphyseal cartilages and periosteum, and we must look for some other factor in the causation.

Pathology furnishes many examples of chronic disease attended by proliferation of tissue, the causes of which are not uniform. Cirrhosis, with its proliferation of hepatic connective tissue, which, as we shall see, presents a similitude in some respects to rachitis, is sometimes undoubtedly produced by the irritating action of a chemical agent, to wit, alcohol; but all physicians know that there are many cirrhotic patients who refrain entirely from the use of alcohol in any form. In like manner, it seems to me that, if we admit, as we must in the light of experiments, that certain chemical agents, notably phosphorus and lactic acid, introduced into the system or produced in it, cause rachitis by their irritating action, there are other typical cases in which there is no reason to suspect the operation of such agents. We must, therefore, remain in the belief that rachitis, like many other pathological processes, does not result from a fixed and uniform cause, but from conditions which vary to a certain extent in different patients.

Anatomical Characters of Rachitis.

For convenience of description, the course of rachitis is divided into three periods: (1) That of proliferation and altered nutrition of cartilage and periosteum; (2) That of curvature and deformity; (3) That of reconstruction.

Anatomical Characters in the Stage of Proliferation and Altered Nutrition.—Ossification of a long bone occurs from the epiphyseal cartilages, and from the periosteal or fibrous membrane which surrounds, nourishes, and protects the bone. Growth in length is from the former, in thickness from the latter. As regards the flat bone, while growth in thickness occurs from the periosteum, that in breadth is from the cartilage of its border, which corresponds with the epiphyseal cartilage of the long bone.

Cartilaginous Changes.—If we examine the epiphyseal cartilage of a long bone during normal ossification, we observe, first beginning at the distal end, a white zone, consisting of a hyaline matrix, in which are the usual cartilage cells. This constitutes most of the cartilage. Underneath this, and nearer the bone, is the *zone of proliferation*, the cartilage in which is softer and more yielding than that of the distal zone. in consequence of cell formation, and absorption of the matrix to make way for cell-groups. Each cartilage cell in the proliferating zone has divided into two cells, and each of these cells into two other cells, and the division has been repeated so that eight cells instead of one are observed, surrounded by a common capsule. The capsule becomes distended by the cell multiplication, and by the swelling of each cell, the size of which is considerably greater than that of the parent cell. Near the bone, namely, along the extremity of the diaphysis, the cell-groups, enclosed in their capsules, nearly touch each other, the matrix having, for the most part, been absorbed. The end of the diaphysis is covered with a layer of these cell-groups, about to undergo ossification, with almost no intervening matrix. The proliferating zone has very little depth. It appears to the naked eye as a very thin, scarcely perceptible layer of a reddish-gray color upon the end of the shaft. It is so shallow that it does not perceptibly increase the thickness of the cartilage.

In rachitis, the state of affairs is different. The zone of proliferation, instead of being confined to a single, or at most a double, layer of cell-groups, consists of many layers involving nearly the whole epiphyseal cartilage. The cells, still enclosed in their distended capsules, undergo a more frequent division than in health, so that instead of groups of eight cells, as in the normal state, each group consists of from thirty to forty cells. Therefore, in rachitis, the proliferating cartilaginous zone is a broad cushion, very soft, of a grayish translucent appearance, causing the characteristic swelling observed around the joint. Over the distal end of the proliferating cartilage, there may still be a layer or zone, though perhaps of little depth, of normal cartilage, like that in health.

Osseous Changes.—While this occurs, the ossifying process is also arrested. We indeed perceive an effort in the direction of bone formation. The Haversian canals, surrounded by capillary loops, extend from the bone into the proliferating zone of cartilage. Their extension is effected by absorption of the matrix and appropriation of cell-groups which lie in their way. The cells in these groups, as they enter the Haversian system, become much smaller by a rapid segmentation, forming medullary cells. We also find, as further evidence of the attempt at bone-formation, granules and masses of lime scattered through the cartilage, and here and there spiculæ and nodules of true bone, springing up from the bony substratum of the shaft. Some of the canals extend far into the cartilage, nearly indeed to its free surface, but most of them terminate in its lowest portion. The growth of bone in thickness occurs from the under surface of the periosteum. In health, a soft, vascular, germinal tissue springs from the periosteal surface, and rapidly receives lime-salts, and is transformed into bone. This germinal tissue, consisting largely of capillaries arising from the

fibrous tissue of the periosteum, is a very thin substratum, barely visible, transient, and constantly changing, from its conversion into bone.

In rachitis, this vascular subperiosteal tissue, not undergoing, or undergoing slowly and imperfectly, the osseous transformation, and at the same time increasing more rapidly than in health, under the irritating influence of the rachitic disease becomes a thick layer. Its color and appearance are like spleen pulp, so that the older observers supposed there was a hemorrhagic extravasation between the periosteum and the bone. There is, however, no extravasation of blood, unless it accidentally occur from the numerous delicate capillaries. The resemblance to extravasated blood, or spleen pulp, is due to the abundant growth of large and thin-walled capillaries from the under surface of the periosteum, as shown by the microscope. This vascular outgrowth is, for the most part, quite uniform over the diaphysis of the long bones, while upon the cranial bones its thickness is much greater in one locality than in another. The attempt at ossification also appears in this tissue. Lime-salts are scantily and loosely deposited through it, forming osteophytes—vascular and fragile—rather than true bone.

The question naturally arises, How does rachitis affect bone which is already formed when the rachitic state begins? Virchow's answer is the following: "Rachitis has . . . by more accurate investigation been shown to consist, not in a process of softening in the old bone, as it had previously been considered to be, but in a non-solidification of the fresh layers as they form; the old layers being consumed by the normally progressive formation of medullary cavities, and the new remaining soft, the bone becomes brittle."[1] It seems, however, from the experiments of Heitzmann, that this opinion should be modified, at least as regards rachitis produced by lactic acid. Moreover, in rachitic craniotabes, occurring in infancy, there is certainly bone absorption, for portions of the occipital and parietal bones are absorbed to cause the soft spaces. We must, therefore, believe that there is in rachitis more or less absorption of lime-salts in the bone, in addition to that required in the normal growth of medullary cavities and canals for vessels.

In healthy bone, the earthy salts are in excess of organic matter, nearly in the proportion of two to one; but in rachitis the proportion is reversed, the organic matter being much in excess. The following table gives analyses of rachitic bones by Marchand, Davy, Boettger, and Friedleben:

	Femur.		Radius.		Vertebra.	
	Inorganic.	Organic.	Inorganic.	Organic.	Inorganic.	Organic.
Case I.	20.60	79.40	21.24	78 76	18.68	81.32
Case II.	37 80	62.20 (conval.)	20.00	80.00	32.29	67.71
Case III.	20.89	79.11	...	...	...	...
Case IV.	52.85	47.15	...	...	...	...

[1] Cellular Pathology, Chance's Translation, Lecture xix.

As might be expected, the relative proportion of organic and inorganic matter varies greatly in different cases, and at different stages of the same case. In severe rachitis many bones are affected. It is stated that there is no bone in the entire skeleton that may not suffer, but in mild cases only a few are involved, at least to such an extent as to produce structural changes, appreciable to touch or sight.

Pathology of Rachitis.—In this connection, it is proper to consider the *pathology* of rachitis. What is its nature? Niemeyer, in my opinion, expresses the correct view, when he says "it seems to me that the most probable hypothesis regarding the cause of rachitis is that which refers it to inflammation of the epiphyseal cartilages and periosteum." The increased vascularity of the periosteum, the proliferation of periosteum and cartilage, the tenderness and pain on motion, and the febrile movement in acute forms of the disease, indicate inflammation rather than any other recognized pathological state. The rachitic inflammation as it affects the osseous system, appears to be of a chronic or subacute character, presenting an analogy with certain other well-known inflammations, such as cirrhosis and certain forms of chronic nephritis, in which proliferation of connective tissue and sclerosis occur. The eburnation rather than normal ossification, which terminates the rachitic process, may properly be considered an osteosclerosis. Comformably with the theory of the inflammatory nature of rachitis, the periosteum is found infiltrated and thickened, and of a reddish hue from hyperæmia, and from the presence of the newly formed capillaries underneath, which have been described above as forming a layer of considerable thickness, known as the "germinal, vascular tissue." Moreover, as in inflammation, some secretion along with the vascular growth occurs over the bone from the under surface of the periosteum. The various interspaces in long, short, and flat bones, the diploë, cancelli, and interlamellar openings, contain a substance similar to that exuded under the periosteum. It appears to be an inflammatory exudation.

Anatomical Characters in the Stage of Deformity.—Rachitic bone, when the disease has continued for some time and is still in its active period, presents a bluish or dusky-red appearance, from its increased vascularity. After a variable time, weeks or months according to the severity of the disease, deformities begin to appear.

Spiegelberg's description of the appearance of the rachitic fœtus corresponds for the most part with what I observed in the one whose skeleton is represented in Fig. 6. According to this writer, the body and limbs are plump: the latter short and curved; the abdomen large and prominent; and the head sometimes hydrocephalic. The skin is thick and loose, and the adipose tissue well developed; the liver large; the epiphyses swollen and soft; the short and curved diaphyses sometimes broken. The rotundity of the thorax is preserved, and the sternum is not carried forward, since there has been no respiration; the ribs, in softness and liability to fracture, correspond with the long bones of the extremities. The sternum, most of all the bones, shows the delay in ossification; the clavicle is among those least affected. The cranium

may be represented by a membranous bag with *plaques* of bone, or the cranial bones may be formed and in shape, but thickened, and softened; the sacral promontory is pressed forward and downward; the sacral vertebræ flattened; the ilia flattened and widened, and the pubic arch increased.

It is interesting to compare these deformities with those in the child, since they occur under conditions so very different. Rachitic bone seldom retains its normal form or shape; its projecting points are rounded, and as soon as it softens, it begins to yield to pressure exerted upon it. Hence the curvatures, so common and characteristic. The portion of a long bone which is formed after rachitis commences, contains so little earthy matter that it bends readily in its fresh state, either by muscular action or by the weight of the trunk, "in the manner," says Vogel, "of a quill or willow stick." The interior of the bone, which was formed before rachitis began, and which contains nearly or quite the normal proportion of lime, is apt to break instead of bending, but, as it is surrounded on all sides by the soft tissue, the fragments are not displaced, and probably do not crepitate. So scanty is the calcareous deposition in typical cases, that, says Trousseau, "the bones . . . . can be cut with a knife with as much ease as a carrot or other soft root," and the dried specimen weighs but from one-sixth to one-eighth as much as normal bone. One writer states that the dried rachitic bone is sometimes so porous, from the small amount of lime which it contains, that it is possible to respire through it, as through a sponge.

In ordinary cases, the bones which exhibit most strikingly the rachitic change, and which, therefore, should be carefully examined in making the diagnosis, are the cranial bones, the ribs, and the radius—the sternal ends of the ribs, and the lower end of the radius. It is seldom that these bones do not give evidence of the disease, if it be present, and in greater degree than other bones. They are the first to be affected to an extent that is appreciable to the observer.

Changes in the Cranial Bones.—In these bones interesting and important alterations occur. Their edges, which correspond with the epiphyseal cartilages, undergo proliferation, and become thickened like the latter. This thickening, and the delayed union of the sutures, produce *grooves*, which can be traced by the fingers between the bones, and which are sometimes appreciable to the sight. Rachitis causes some *enlargement* of the cranium, but the enlargement seems greater than it really is, on account of the retarded growth of the facial bones. In a discussion on rachitis in the London Pathological Society, reported in the *Lancet*,[1] it was stated that in seventeen rachitic children, with an average age of 4.72 years, the average circumference of the head was 21.22 inches, while in the same number who were non-rachitic, and with an average age of 6.05 years, the average circumference was 19.95 inches.

The retarded ossification is manifested not only in the open sutures, but also in the large size and patency of the *fontanelles*, which are not

[1] Lancet, 1880, vol. ii. p. 1017.

closed till long after the usual time. The anterior fontanelle should be closed between the fifteenth and twentieth months, but, in the rachitic, it remains membranous till after the second year, even into the third or fourth year. Since examination of the anterior fontanelle is important in determining whether or not rachitis be present, it should be borne in mind that, in the normal state, this space increases in size till the seventh month, when it is at its maximum, and that after the ninth month it becomes progressively smaller.

The *shape* of the rachitic head varies. In general, instead of its normal rounded form, it approaches a square shape. Another type is sometimes observed in which there is no marked angularity, but in which the antero-posterior diameter is enlarged. In the square head, the forehead projects, and both the frontal and parietal protuberances are unusually prominent. The sutures are depressed to a certain extent, as has already been mentioned, and the anterior, lateral, superior, and posterior surfaces of the cranium are more flattened than in health. The lambdoidal suture, which should close by the fourth month, and the sagittal, which should close by the end of the first year, have made little progress towards union when the second year begins. The undue prominence of the frontal and parietal bosses takes its origin from the exaggerated proliferation of the periosteal or fibrous covering of the bones.

Craniotabes.—Thinning of the cranial bones in places so that the brain lacks proper protection, has long been noticed in the examination of rachitic heads, but the injury that results to the infant was overlooked till pointed out by Dr. Elsässer. Craniotabes occurs for the most part in patients under the age of one year, and a large proportion are under eight months. Its occurrence in the fœtus, as shown by a case published in the *New York Obstetrical Journal* in 1870, and by Heitzmann's case, has already been alluded to. The factors in producing this thinning are rachitic softening of the bones and pressure; pressure of the brain from within and of the pillow from without. Consequently, the portions of the cranial arch in which the thinning occurs are the posterior and lateral, the occipital bone and the posterior half of the parietal. If the infant lie chiefly on one side, in its crib, on this side the craniotabes occurs, while those portions of the cranium which are not pressed upon, as the frontal bone, exhibit no thinning. The soft spots are yielding when pressed upon, and in the cadaver they are seen to be translucent when held to the light. The amount of absorption varies greatly according to the degree of rachitic softening, and the amount and continuance of the pressure. There may be in some instances simple depressions, like erosions in the bone, with a continuous but thin bony layer remaining; but in other cases, such as have been particularly examined and studied by physicians, the bone absorption is complete over areas of greater or less extent, so that the pericranium and dura mater are in contact. In examining a child for craniotabes, it should be borne in mind that the margins of the bones, even when there is no thinning, but thickening from the cartilaginous proliferation, are flexible in the rachitic. The pressure must be made in a direction away from the sutures, to ascertain whether craniotabes

has occurred. The pressure should at first be made lightly and cautiously, with the fingers, for if there be total absence of bone, unless of very little extent, deep and forcible pressure might injure the brain, for so soft and delicate an organ, covered only by the scalp and dura mater, badly tolerates pressure. If the first examination detect no soft place, the fingers may be pressed more firmly against the scalp, when, if the bone be much thinned, so that there is only a small layer of the lime-salts underneath, it will be found to yield. The sensation communicated to the fingers, when there is an open space in the cranium, and the dura mater and scalp are in contact, has been likened to that experienced when pressing upon a fully distended bladder. At a meeting of the London Pathological Society, reported in the *Lancet* for November 20, 1880, Dr. Lees presented statistics to show that craniotabes was one of the lesions of inherited syphilis; but whether it may result from syphilis or not, the evidence that there is a cranial softening which is strictly rachitic, appears, from repeated observations, to be sufficient.

Symptoms of Craniotabes.—As craniotabes gives rise to peculiar symptoms quite distinct from those of the general rachitic disease, they may be properly considered in this connection. Craniotabes usually occurs during the first year of infancy, and most frequently prior to the tenth month. The brain at this age is soft and yielding, since it contains a large percentage of water. Unless handled with care at an autopsy, it is readily lacerated, and moderate pressure upon it is seen to disturb and move it at a considerable distance from the point of contact. It assists to a proper understanding of the symptoms of craniotabes to recall to mind the fact, well known to surgeons, that slight depression of even a small portion of the skull is apt to produce grave symptoms. It is not surprising, therefore, that craniotabes, when there is a space of considerable size in the cranial arch destitute of bone, is attended by symptoms due to the mechanical effect of external pressure, whenever a substance less yielding than the brain comes in contact with the unprotected part.

Since pressure from the pillow without, and from the brain within, is believed to be the cause of the absorption, the craniotabes must obviously occur in the posterior and postero-lateral portions of the cranium. Corresponding with this explanation of the causation, the thinning actually occurs in the occipital and posterior portions of the parietal bones, while the anterior halves of the parietal bones, and the frontal bones, are even thicker than normal, from the cartilaginous and periosteal proliferation occurring along the sutures and on the surface of these bones, as already described. It is well known that long-continued pressure produces absorption of calcareous matter even more readily than of soft tissues, as is shown in the absorption of a tooth of the first set by the growth of the dental pulp of the second set. In the normal growth of the skull, constant absorption of the under surface of the cranial bones is going on to make room for the enlarging brain, and when no calcareous deposition occurs upon the external surface to compensate for the loss within, we might expect even a greater amount of craniotabes than ordinarily occurs.

Every rachitic infant is fretful, but one with craniotabes is especially so, if the open spaces be of considerable size. If it lie upon the pillow, in its accustomed manner, as is most natural for it, the unprotected portion of the brain may be so pressed upon by the weight of the head, that it feels uncomfortable. It does not have quiet sleep, probably because the cerebral circulation and functions are in a measure disturbed; it is apt to awaken readily and often, and frets till it is taken in the nurse's arms. Sometimes it instinctively seeks a position on the edge of the pillow, with the face downwards, and it becomes more quiet when resting over the nurse's shoulder with the face backward. But if fretfulness, disturbed sleep, and the necessity of closer attention on the part of the mother and nurse were the only ill-effects of craniotabes, it would possess much less pathological significance than pertains to it. Pressure upon so delicate and important an organ as the brain, involves risks and produces serious symptoms in proportion to its degree. Even a slight injury of the skull which produces depression, though it may be of trifling amount, will cause serious forms of nervous disorder. So craniotabes is believed to sustain a causative relation in certain cases to one of the most dangerous of the neuroses, namely, *laryngismus stridulus*, an affection which is also designated "internal convulsions," "spasm of the glottis," and "Kopp's asthma," although Kopp was not the first to describe and recognize the malady. The etiology of this neurosis has not been fully elucidated. It is certain that a large proportion of those who suffer from it are rachitic, and that it is more common and severe where rachitis is prevalent, as in England, than where it is rare, as in the rural districts of America. It is not often the cause of death in this country, and the fatal cases that do occur are only seen in cities, whereas in parts of Europe, where rachitis is much more common than with us, it causes many deaths.

Certain infants, when in a state of excitement, have what are termed "holding-breath spells." The face is flushed, and breathing ceases for some seconds, after which respiration returns and is normal. These attacks are unimportant, but they appear to be the same in nature with the more severe and dangerous seizures of laryngismus stridulus. They have no pathological significance, excepting as they show the same neuropathic state as that in laryngismus, and as they may be precursors of this disease. Laryngismus stridulus, or glottic spasm, is usually preceded by more or less impairment of the general health, and often by fretfulness, which is characteristic of the rachitic state; but the attack occurs suddenly, without premonition and is of short duration. It begins with an arrest of respiration, a true apnœa, as if from paralysis of the respiratory centre in the medulla. The lips may be livid; a pallor spreads over the face; sometimes more or less rigidity of the limbs occurs, with carpo-pedal contractions, and after a few seconds, a quarter or a half minute, a long and deep but difficult inspiration through the narrow chink of the glottis follows, accompanied in many patients by a whistling or crowing sound, and the attack ends with, perhaps, a momentary look of bewilderment, or dread, on the child's face. Now this disease, like eclampsia, does not have a uniform causation. In certain cases, it appears to be a reflex phenomenon, due

to an irritant in some part of the system, as in the intestines; but many observations have established the fact that rachitis, also, sustains a causative relation to it. A large proportion of the infants affected with laryngismus exhibit unmistakable rachitic signs, and, in the opinion of many experienced observers, the exposed state of the brain affords explanation of the fact that so many of the rachitic have this neurosis. Still from observations which I have made, and from those of other observers, like Senator, it is certain that laryngismus stridulus

Fig. 7.

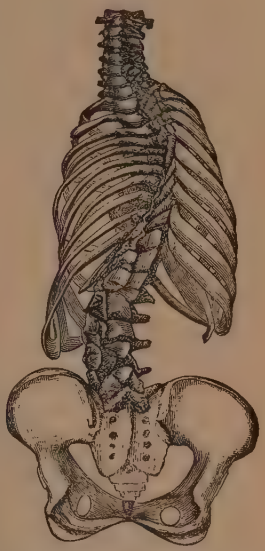
Head of a rachitic child in the New York Infant Asylum.

is common in the rachitic who do not have craniotabes, so that there must be a causative relation in rachitis to laryngismus independently of the cranial softening. The accompanying woodcut represents the rachitic head of a child in the New York Infant Asylum. This patient had also attacks of laryngismus stridulus.

Changes in the Vertebræ, etc.—The short bones which participate in the rachitic disease, become softer and more yielding, and their cancelli are filled with a reddish pulpy substance. In many rachitic cases, the vertebræ are but slightly involved, so that no deformity of the spinal column results; but occasionally, when many bones are affected, the vertebræ and intervertebral cartilages soften, and spinal curvatures result. The curvatures are due to the weight of the shoulders and head on the spinal column. They are, with some deviations, an exaggeration of those present in the normal state. Rachitic curvatures of the spine are, therefore, mainly antero-posterior with some lateral deflections. Where there is much curvature, the vertebræ become wedge-shaped, narrowed upon the concavity, and thickened upon the convexity. The intervertebral cartilages are also more or less changed by the pressure, being thinned where the vertebræ approximate to each other, on the concave aspect of the curvature, and of normal thickness or thicker

than normal upon the convexity. The accompanying woodcut exhibits the nature and appearance of rachitic spinal curvature in the adult. Rachitis having occurred at the usual age, resulted in the permanent deformity here illustrated. In extreme cases, fortunately rare, the functions of important organs may be seriously impaired by the curvature and consequent compression, as in Pott's disease. Thus, according to Miller, the aorta has been so doubled upon itself as to diminish materially the flow of blood to the lower extremities, and sensibly impair their nutrition. The effect of so great curvature upon the functions of the heart and lungs must obviously be detrimental.

Fig. 8.



Rachitic spinal curvature in an adult. (From a specimen in the Wood Museum, Bellevue Hospital.)

At first the spinal curvatures disappear when the child reclines, or is lifted by the axillæ, so as to raise the head and shoulders from the spine, but when the deformity has continued so long that the vertebræ and cartilages have become wedge-shaped, it remains for life, or can only be rectified slowly and with diffculty by mechanical appliances. As seen in the woodcut, the common curvature in the dorsal region is backward (*kyphosis*), while to compensate the patient instinctively carries the neck forward, with the head thrown back, causing cervical *lordosis*, a similar anterior curvature being common in the lumbar region. Lateral curvature (*scoliosis*) may or may not be present, even when there is considerable antero-posterior flexure. Scoliosis is sometimes produced by the nurse, in carrying the infant habitually over one arm.

Changes in the Maxillæ.—Fleischmann has investigated the changes which rachitis produces in the maxillary bones. Stunted growth of the facial bones, generally, has long been known, and has been remarked upon by various writers; but, according to Fleischmann, other interesting changes occur in the jaw-bones, which affect the direction and position of the teeth. According to this author, the arched shape of the lower jaw becomes polygonal, and the direction of the alveolar process also changes, so that it inclines inward. This deviation in the arch, and in the alveolar process, which begins in the region of the canine teeth, necessarily causes shortening of the lower jaw. Commencing soon after, a change is observed in the upper jaw-bone from the zygomatic arch forward, so as to cause lengthening of this bone, changing here also the shape of the arch and the position of the teeth. The lateral incisors, instead of being in front, have a lateral position, and the incisors and molars diverge, so that when the jaws are closed they overlap the corresponding teeth of the lower jaw in front and upon the sides, a condition the opposite of that seen in the jaws of old people. Fleischmann attributes these changes in the lower jaw to the action of

the masseter and mylo-hyoid muscles, and perhaps the genio-glossus, and to pressure of the lip, the deficiency of earthy salts in the bone rendering it more easily acted on by the muscles. The change in the upper jaw-bone he attributes to lateral pressure of the zygomatic arches.

Changes in the Ribs.—The ribs are early affected in rachitis. The swelling of their anterior ends, where they unite with the costal cartilages, producing the "rachitic rosary," has been already alluded to as one of the first and most conspicuous signs of rachitis. The costo-chondral articulations are enlarged in all directions, appearing as nodules under the skin. If an opportunity occur of inspecting, at an autopsy, the pleural surface, the nodular prominences are seen to be even greater and more distinct there than under the skin.

The deformity of the thorax consequent upon softening of the ribs is interesting. Commencing with the spine, the ribs extend nearly di-

FIG. 9.

Rachitic child with characteristic deformity of head, ribs, and radius. (From a patient in the New York Foundling Asylum.)

rectly outward; at the union of the dorsal and lateral regions, they make a short curve forward, and then turn inward, also with a short curve toward the sternum (Fig. 10). This abrupt bending of the ribs, which, in their softened state, has been caused by atmospheric pressure during respiration, produces a depression in the thoracic wall at about the point where the ribs and their cartilages unite. A groove extends on the antero-lateral surface of the thorax from the second or third rib downward, and a little outward. Sometimes the bottom of the groove is occupied by the costo-chondral joints; in other cases these joints are a little to one side of the deepest part of the groove. The transverse diameter, therefore, of the anterior half of the thorax is much less than in health. This necessarily diminishes the lateral expansion of the

lung in inspiration, and causes unusual prominence of the sternum. Hence the expressions "pigeon-breasted," "resemblance to the prow of a ship," etc., applied to this deformity. The presence of the heart renders the groove more shallow on the left side, at the fourth and fifth ribs, than on the opposite side, since this organ affords partial support to the chest-wall. On the other hand, the right groove is not as long as the left, as the lower ribs on this side are partially supported by the liver. On both sides, however, the lower part of the thorax, that below the seventh, eighth, or ninth ribs, widens, being pressed outward and supported by the abdominal viscera. There is, therefore, in addition to the longitudinal groove, an antero-posterior depression, sometimes also spoken of as a furrow or groove, on either side, lying between the sixth and ninth ribs.

The ribs with their attached muscles are important agents in respiration, but the soft and yielding nature of the ribs, in the rachitic, retards,

FIG. 10.

Deformity of chest in rachitis.

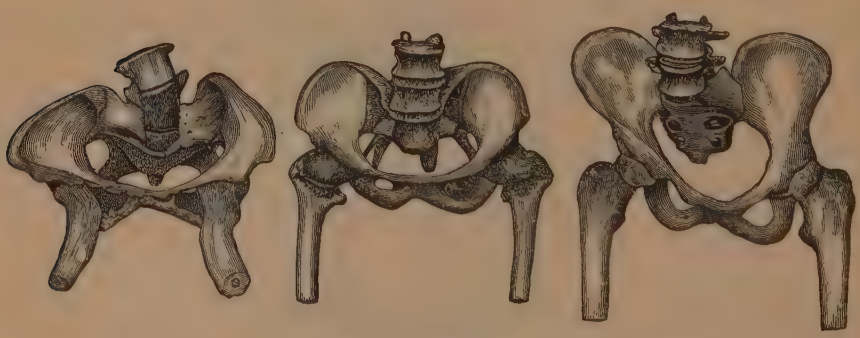
and to a great extent prevents, the lateral expansion of the thorax which is necessary for normal and full inspiration. The action of the respiratory muscles, and the pressure from within of the air descending along the air passages, is not sufficient to overcome fully the external atmospheric pressure, in the absence of proper resiliency of the ribs. Consequently, with each inspiration, we observe more or less sinking in of the thorax on either side, just as when a moderate obstruction to the entrance of air exists in the larynx or trachea. As the ribs become

firmer from the deposit of lime-salts, respiration is more regular and normal.

Changes in Bones of Upper Extremity.—Although swelling of the lower end of the radius (see Fig. 9) is one of the earliest signs of rachitis, the bones of the upper extremities are less frequently curved and distorted than those of the lower extremities. The *clavicle* sometimes softens and bends, producing two curvatures, one backward, near the scapula, and another of larger size nearer the sternum, directed forward and a little upward. Careful examination shows, in some rachitic patients, thickening of the margins of the *scapula*, like that of the cranial bones. The *humerus* is occasionally bent, and usually at the point of insertion of the deltoid, in consequence of the powerful action of this muscle in raising and supporting the arm. The *radius* and *ulna* are bent outward and twisted. The deformity is attributed by Sir. William Jenner to the fact that ricketty children support themselves, while in the sitting posture, upon the palms of the hands pressed upon the floor or couch. Supporting the weight of the body in this way not only, in his opinion, causes bending of the ulna and radius, but also aids in producing the deformities of the humerus and clavicle.

Changes in Bones of Pelvis.—The deformities of the pelvic bones, resulting from rachitic softening, are, in the female infant, the most important of any which the skeleton undergoes. They are produced by

Fig. 11. Fig. 12. Fig. 13.



Rachitic deformities of the pelvis. (From specimens in the Wood Museum.)

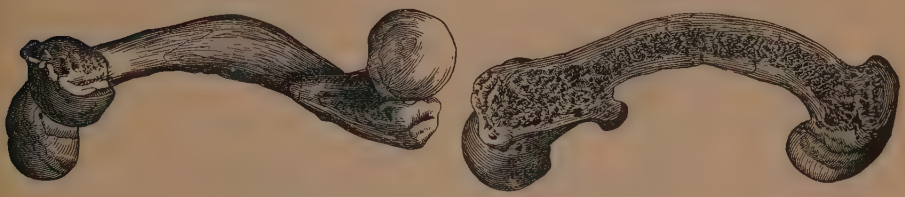
pressure from above of the abdominal organs, serving to widen the brim of the pelvis, and also by pressure of the spinal column, sustaining the weight of the trunk, shoulders, and head, pressing forwards the promontory of the sacrum, in the sitting posture, and thus diminishing the antero-posterior diameter of the pelvic brim. There is, moreover, two-fold pressure from below, that caused by the heads of the thigh-bones, in standing, and that exercised by the tuberosities of the ischia, in sitting. Both these forms of pressure have a tendency to narrow the outlet of the pelvis. Hence the marriage of the female who has been rachitic in infancy may involve serious consequences. Many of the

tedious instrumental labors in the families of the city poor, which severely tax the patience and endurance of young practitioners, are attributable to rickets in early life.

Changes in Bones of Lower Extremities.—The curvature of the *femur* is usually forward, or forward and outward. The neck of the femur sometimes bends by the weight of the body, or by use of the legs, so that the angle which it forms with the shaft is changed. The annexed woodcuts show the rachitic bend of this bone in an adult, years after rachitis had ceased, and when the bone had become consolidated by the new deposition of lime-salts.

The curvature of the *tibia* and *fibula* varies. In those under the age of one year, it is apt to be outward, so that the knees are separated from

FIG. 14. FIG. 15.



Rachitic deformities of the femur (Wood Museum.)

each other. In those old enough to stand, the weight of the body usually determines a forward bending of these bones. In one case in my practice, an anterior curvature so abrupt that an angle of about 70° was formed, existed about four inches above each ankle. This patient, though old enough to walk, almost constantly sat during the day with the feet extended beyond the sofa, so that the edge of the latter corresponded with the concavity of the legs. It seemed to me that the weight of the feet must have been a factor in causing these curvatures, especially as the case was one of very marked rachitic softening of different bones. Still, tibial and fibular bending at this point has been noticed by different observers, who have attributed it to the weight of the body in walking. Various other curvatures, besides those mentioned, occur in the bones of the lower extremities, the direction in which the limbs bend being determined by the particular circumstances of the case.

In mild cases of rickets, most of the deformities described above are lacking, but in typical cases certain of them stand out prominently, so as to be readily detected by one familiar with the disease. In all such cases the diagnosis is easy beyond that of most other maladies, for the changes which occur are not only conspicuous, but pathognomonic.

Rachitis produces another important effect on the skeleton. Its growth is *stunted*, not only during the rachitic period, but subsequently, so that those who have been rachitic in childhood, unless very mildly, have less than the average stature in adult life. The stunted growth is apparent, though ample allowance be made for curvatures. The arrest of development is greater in some bones than in others. It is greatest in the bones of the face, pelvis, and lower extremities.

Stunted growth of the pelvic bones of the female infant conjoined with the deformities alluded to above, may seriously affect her subsequent life, and a rachitic pelvis in the female, exhibiting both stunted growth and deformity, constitutes a valid reason for avoiding marriage. As a

Fig. 16.

Fig. 17.

Rachitic deformities of the femur, tibia, and fibula. (Wood Museum.)

rule, the older the child is when rachitis begins, the less is the skeleton affected, and the less consequently is the deformity.

Effect of Rachitis on Dentition.—As might be expected from the nature of rachitis, dentition is delayed. If the disease show itself before any tooth has appeared, the first teeth, to wit, the lower central incisors, will probably not appear before the ninth or tenth month, or even later. Sir Wm. Jenner considers the non-appearance of a tooth by the ninth month, with few exceptions, a sign of rachitis. Teeth which appear during the rachitic state are frail, deficient in enamel, and crumble readily. They become carious, rot, and break before the usual time. If certain teeth have appeared when rachitis begins, several months elapse before others cut the gum. It is even said that a child who has rachitis severely may never have a tooth, may remain toothless for life; but I have never observed such a case. Ordinarily, when the rachitic state ceases, and the health is fully restored, dentition goes on as before. The arrest of teething, so easily observed, has long been considered one of the most reliable diagnostic signs. The physician cannot justly pronounce on the nature of the disease in a case of suspected rachitis, unless he first carefully inspects the gums.

Changes in the Soft Tissues.—Although the conspicuous lesions of rickets pertain to the skeleton, the soft tissues are also more or less implicated. The *ligaments* become relaxed and flabby, giving unusual mobility to the joints, and unsteadiness to the movements. The fibrous bands which unite the vertebræ, as well as the ligaments of the extremities, participate in the relaxation. In certain patients, the *muscles* throughout the system, partly, perhaps, in consequence of the gastro-intestinal disturbance, indigestion, and malnutrition; partly, perhaps, from want of use (for the rachitic are apt to be quiet), become shrunken and flabby. The *spleen* is frequently enlarged, as ascertained by palpation and percussion. Ritter von Rittershain found this organ decidedly enlarged in ten out of thirty-five cases which he examined after death. The enlargement is the result of cellular proliferation, common in diseases which are attended by dyscrasia. The *liver* in many patients undergoes no perceptible change, except that it may be pushed a little downwards. It is occasionally found enlarged from fatty infiltration, but no special significance attaches to this, for fatty liver is common in various forms of disease attended by innutrition and wasting. It is common in tuberculosis, and in protracted intestinal catarrh, and its pathological significance appears to be the same in these various diseases. There can be little doubt that Sir Wm. Jenner errs when he states that albuminoid infiltration of the liver is common in rachitis. Parry, Gee, Dickinson, and Senator agree that it is rare, and that if it does occur, it is by coincidence.

In a discussion on rachitis, in the London Pathological Society, Dr. Dickinson[1] spoke of enlargement of the spleen, liver, and lymphatic glands, which he had observed in rachitic cases. According to him, the spleen undergoes the greatest enlargement, the lymphatic glands the least, and, of the latter, "the mesenteric glands show the most decided swelling." The spleen in some patients has been so large that it occupied the greater part of the left half of the abdominal cavity, but a less degree of enlargement is the rule. The liver is apt to extend one or two inches below the ribs. The swelling, Dr. Dickinson adds, is not amyloid. "There is no new growth or deposit, only an irregular development of the proper tissues of the organs." He believes that both the corpuscular and interstitial elements are increased in the liver, spleen, and lymphatic glands. But other members of the Society had observed this enlargement only in occasional cases, and they considered it due rather to the state of health which caused rachitis than to rachitis itself. Dr. C. Hilton Fagge stated that he had failed to find swelling of the liver, spleen, or lymphatic glands, in a large majority of cases.[2] An undue development of the lymphatic glands from hyperplasia is very common in children in various states of ill-health, and the mesenteric glands are especially apt to become enlarged from this cause in protracted cases of intestinal catarrh or irritation.

The *abdomen* is *protuberant* from various causes. The lateral depression of the thoracic walls causes the liver and spleen to descend a little lower in the abdominal cavity than natural. The enlargement

[1] Lancet, December 11, 1880.

[2] Lancet, November, 20, 1880.

of the liver and spleen, the feeble tonicity of the intestinal muscular fibres, and consequent distention of the intestines with gas, and the rachitic shortening of the spinal column, which causes approximation of the ribs and pelvis, necessarily produce abdominal protuberance.

The *kidneys* themselves are not diseased in rickets, but there is an exaggerated discharge of phosphates in the urine, and, as stated above, lactic acid and free phosphoric acid have been found in this excretion. The urine is commonly pale; its urea and uric acid are diminished; and it sometimes contains a sediment of oxalate of lime.

The *brain* is usually well developed, and appears healthy, with the normal proportion of white and gray substance. In one case the weight of this organ was ascertained by Dr. Gee to be fifty-nine ounces, and in another forty-two and a half ounces. In both brains the proportion of white and gray substances, and their color and consistence, seemed normal.

Anatomical Characters of the Third Stage, or that of Reconstruction.—This stage will be better understood, if we recollect what has occurred during the first and second stages. The very vascular periosteum is drawn tightly over convexities, the pressure upon which diminishes the hyperæmia and the amount of exudation underneath. Over the concavities the periosteum is loose; it is hyperæmic, with abundant new capillaries, the interspace between it and the bone being filled with the gelatiniform substance already described. The reparative process goes forward more rapidly, and the deposition of lime-salts is more abundant upon the concave surfaces, where there have been free exudation and no compression of the capillaries, than elsewhere. The lime-salts are deposited from the blood. Consequently, from the increased capillary circulation and hyperæmic state of the periosteum produced by rachitis, the chalky matter is rapidly effused wherever there is an open space under the periosteum, and where the capillaries are in a state of engorgement. Hence the reconstructed bone is thicker and firmer upon the concave aspect of the long bones than elsewhere, and thinnest upon the convex aspect where the periosteum is more tense, and its capillaries more or less compressed.

It is a question whether true ossification occurs at first during the reparative stage. The deposition of chalky matter is designated by some writers as a petrifaction rather than a true bone-formation. Trousseau likens it to the formation of callus after a fracture. It certainly produces a substance more compact than ordinary bone. The term "eburnation" has been applied to this new osseous formation, and I have designated it "osteo-sclerosis." Some years since I examined microscopically an adult bone which exhibited the rachitic curvature in a marked degree, and was very hard. It contained the elements of true bone, but I was in doubt whether the part examined was formed during convalescence from rickets, or in the subsequent growth.

Recovery from rickets is gradual. Little by little, the cartilaginous and periosteal proliferation ceases, the hyperæmia abates, and the bone-producing tissues return to their normal state. Certain of the deformities are permanent, but others disappear in the further growth of the skeleton.

Symptoms of Rachitis.

Preceding and accompanying rachitis, symptoms may be present which are due to indigestion and intestinal catarrh, such as flatulence, unhealthy stools, and poor or capricious appetite. When rachitis begins, the infant becomes fretful; its sleep is apt to be restless and disturbed, and it awakens often. It repels attempts to amuse it, and is apparently annoyed by them. Nurse and mother speak of it as a cross child. It perspires freely from the head and neck, both when awake and when asleep, while the extremities and trunk are dry. Its pillow is wet with perspiration during sleep, and sweat drops may be seen upon forehead and face. If the surface be dry, a little excitement or elevation of temperature causes the perspiration to appear. The rachitic child does not well tolerate the bedclothes, and attempts to throw them off from its limbs, even in cool weather, lying exposed, and causing considerable annoyance to the nurse, who strives to prevent its taking cold. Sometimes miliaria, due to the moist state of the skin, appear upon the face and neck. The subcutaneous veins which return blood from the head are large, and the jugular veins full.

Another symptom is soon observed, to wit, tenderness over a considerable part of the surface, perhaps largely due to the morbid state of the periosteum over so many bones, though it is also experienced when pressure is made upon the soft parts of the abdomen. The tenderness is probably, in part, the cause of the fretful disposition. The little patient appears to dread to be touched; its flesh is sore; it repels attempts to amuse it, and wishes to be quiet. Dandling it upon the arms, swinging it, or even walking with it, which delights the healthy child, and elicits a smile or notes of glee, only adds to its discomfort. It is most at ease when left alone, upon a soft cot or pillow, or, if it have craniotabes, when quietly held over the shoulder. Languor, disinclination to use the limbs, or to play, moderate thirst, with other symptoms referable to the digestive apparatus, which are present in many cases, and which have already been described, are soon followed by changes in the skeleton, which are perceptible to the sight and on palpation. The pulse and temperature, in a large proportion of the ordinary chronic cases, do not deviate from the healthy state, except that in some patients there is a slight febrile movement in the latter part of the day.

Although rachitis is ordinarily a chronic disease, insidious in its commencement, gradual and progressive in its development, occupying months, there is an acute form which is attended by more marked febrile movement and tenderness, and in which the articular swelling appears more quickly.

A *bruit de soufflet*, of greater or less intensity, synchronous with the pulse, has frequently been heard in rachitic cases by applying the ear over the anterior fontanelle, Drs. Whitney and Fischer, New England physicians, first called attention to this murmur, believing it to be a sign of chronic hydrocephalus. MM. Rilliet and Barthez heard it in cases of rachitis, and, therefore, concluded that the American physicians

had confounded the two diseases. More recent observations have established the fact that this *bruit* has little diagnostic value. It is heard whenever there is sufficient patency of the anterior fontanelle, both in health and disease, for sound is conducted better through a membrane than through bone. Dr. Wirthgen heard the *bruit* in 22 out of 52 children, of whom all except four were in good health. I have auscultated the anterior fontanelle in 29 infants, who were with two exceptions between the ages of three and thirty months. All were well, or having merely trivial ailments which did not affect the cerebral circulation. In most of them a murmur could be distinctly heard, synchronous with the respiratory act, and in 15 of the 29 cases no other sound could be detected, while in the remaining 14 a *bruit* could be detected, synchronous with the pulse.

Complications and Sequelæ of Rachitis.

These have been in part described in the foregoing pages, out there are certain other results of the disease to which it is proper to call attention. If the deformity in the thoracic wall, namely, the lateral depression of the ribs and anterior projection of the sternum, be great, we would naturally expect that the two important organs underneath, the heart and lungs, would receive some detriment. Upon the surface of the *heart*, at the point where it supports the softened ribs, a white patch is often found, due to thickening of the pericardium and proliferation of the endothelial cells, just as thickening of the skin in the palm of the hand occurs from friction and pressure upon that part. It is probable that this pressure does not seriously impair the function of the heart, but it may increase the weakness of its movements in any asthenic disease which may occur during the rachitic period. The injury sustained by the *lungs* is greater and more apparent. If the ribs be flexible, and much depressed, full inflation of the lung cannot occur in those parts where the depression is greatest. Semi-collapse of certain lobules is apt to occur, and even complete collapse of the thin edges of the lung. The stress of respiration falls unequally upon different parts of the lung. The anterior portion, which ascends with the sternum as that is propelled forward, is more fully dilated than the lateral and posterior parts, and hence is apt to become emphysematous. If in this state of the thorax and lungs, severe bronchitis or broncho-pneumonia arise, the state is one of great peril. The mucus and pus being expectorated with difficulty, clog the tubes and produce dyspnœa. Full inspiration in the lateral and depending portions of the lung, which is required in order to expel these secretions, not occurring, the result may be unfavorable, even in comparatively mild forms of inflammation. Bronchitis and broncho-pneumonia are the causes of death in not a few cases of severe rickets. Certain writers state that chronic *hydrocephalus*, *diarrhœa*, and *eclampsia* may complicate rachitis. I have not seen any case in which rickets seemed to sustain a causative relation to either hydrocephalus or diarrhœa, but we know that diarrhœa frequently precedes and accompanies rachitis, and its relation to it is that of cause rather than

effect. This subject has been sufficiently treated of in preceding pages. Rachitic infants appear to be more liable to eclampsia than those who are healthy. This would be inferred from their liability to laryngismus stridulus, a neurosis whose pathology is similar to that of eclampsia.

Diagnosis of Rachitis.

Rachitis in many instances continues a considerable time before its nature is suspected, the symptoms to which it gives rise being overlooked, or attributed to other causes than the true one; and yet it is important that an early diagnosis be made, for it is much more amenable to treatment in its early than in its later stages. The deformities which mar the beauty, and to a certain extent impair the activity and usefulness, of so many who have been rachitic in childhood, may often be prevented by early diagnosis and treatment. Many with this disease do not show the usual signs of faulty digestion and innutrition, especially on casual inspection, for there may be considerable adipose development and rotundity of features and form in a rachitic child; while, on the other hand, there are numerous instances of malnutrition and wasting without rachitis. Early diagnosis, when the affection is of a mild type, is necessarily difficult, but a watchful and painstaking physician will commonly detect the disease before it has run many weeks, if he bear in mind its frequency, and carefully examine the patient.

If called to a suspected case, we should inquire into the history and particularly whether there have been signs of intestinal catarrh or innutrition. The gums should be inspected to ascertain whether there is backwardness in dentition, and the head, to note its shape and size, whether it is elongated, or whether it approximates the square shape, with broad forehead and large protuberances. We should notice also the state of the fontanelles and sutures, and whether softening and thinning of the cranial bones be present. The costo-chondral articulations and those of the wrist, should also be carefully examined to ascertain if there is any enlargement, and the shape of the thorax, which begins to exhibit the rachitic deformity at an early stage of the disease, should likewise be noticed. We should also examine the child in reference to other less prominent signs, such as spinal curvature, abdominal protuberance, muscular weakness, and relaxation of ligaments (which produce feeble and unsteady use of the limbs), perspirations upon the head and neck from slight excitement, and during sleep, fretfulness, etc. If rachitis be present, certain of these signs will be observed.

The late Dr. Parry called attention to the importance of making a differential diagnosis between the *pseudo-paraplegia of rachitis* and true paraplegia, which is the prominent symptom of *infantile paralysis*. The rachitic child, from muscular weakness and ligamentous relaxation, and from the soreness and tenderness common in this condition, may seldom use his legs; may sit or lie quietly at the age when healthy children, if awake, are constantly moving their limbs. If we attempt to make him walk or stand, his legs may be so limp and powerless that they give way under his weight, but this is a different state from paralysis.

In paralysis, the fault is in the nervous system—usually in the nervous centres—whereas, in rachitis, it is in the muscles and ligaments. The rachitic child, when sitting or lying down, readily moves his legs if his feet be tickled or pinched, while the paralyzed limb responds to the irritation imperfectly. In infantile paralysis, the loss of muscular power is, with few exceptions, confined to the muscles of the lower extremities; but in rachitis, the muscular feebleness is more general, being noticeable in the arms as well as in the legs. Great relaxation of the ligaments is in most instances due to rachitis. It is especially noticeable in the ankle and knee-joints, and is a diagnostic sign which should not be overlooked in the examination of a suspected case of the disease.

Prognosis of Rachitis.

The prognosis of rickets is usually favorable, provided that no serious complication arises. Rachitis is not in itself fatal, under ordinary circumstances. If there be much lateral depression and narrowing of the thorax, the functions of the heart and lungs may be embarrassed, and if the patient have a severe *bronchial catarrh* or *broncho-pneumonia*, the condition becomes one of danger. Rachitic children seem to be especially liable to catarrhal attacks of the air-passages, and even a moderate catarrh, with a deformed thorax, may prevent proper decarbonization of the blood, and cause lividity and dyspnœa. Therefore, now and then, a rachitic child succumbs to an attack of inflammation of the respiratory apparatus, which would not have been fatal if there had been no rachitic deformity. We have seen that in whatever way it may act to produce this form of spasm, rachitis is a cause of *laryngismus stridulus*. Occasionally spasm of the glottis is fatal, but cases with such a termination are rare in America, though not infrequent in some European countries.

Of the diseases of childhood which rachitic children tolerate badly, and which may prove fatal in consequence of rachitic bone-softening and deformity, *pertussis* should be mentioned. If this be severe while the ribs are soft and yielding, and there be lateral depression of the thorax, the spasmodic cough produces great suffering and involves danger. Lividity, feeble action of the heart, pulmonary and cerebral congestion, and eclampsia, may occur. *Measles*, if it be attended by considerable bronchitis, and especially if it be complicated by broncho-pneumonia, is also one of the dangerous intercurrent diseases. The gravity of these inflammations of the respiratory apparatus is usually proportionate to the degree of recession of the ribs during inspiration. With these exceptions, and with that of risk to the married female who has deformity and stunted growth of the pelvic bones, the rachitic are not liable to any ulterior serious consequences. Minor deformities, in mild cases, not infrequently disappear in the subsequent growth of the skeleton. The older the child is when rachitis begins, the milder is ordinarily the form of the disease, and the more speedy, consequently, the recovery, and the less the deformity. In the gravest cases, the disease will almost always be found to have begun under the age of one year.

Treatment of Rachitis.

Since rachitis sometimes develops in the fœtus it is important, in order to prevent this malady, that the parentage be healthy. The pregnant woman should lead a quiet and regular life, with sufficient exercise to produce healthy digestion, but without too arduous work, and with regular meals and wholesome diet. By the observance of such rules fœtal rachitis might probably, in most instances, be prevented. Most cases of rachitis, however, commence in infancy, so that by proper management of the infant, we may hope to prevent, and usually can prevent the occurrence of this disease.

The correct treatment of rachitis is apparent when we consider its character and the nature of its causes. The obvious indication is to restore healthy nutrition. This requires both hygienic and therapeutic measures. The apartment in which the child resides should be dry, airy, and plentifully supplied with light. He should be taken daily into the open air, in order to invigorate his system, but in such a way as not to increase his suffering, on account of his general tenderness. Residence in the country is far preferable to that in the city, because of the better hygienic conditions which it procures. The purer air, the better diet, and consequently the more robust development gained by rural life, are important advantages, to obtain which is abundantly worth pecuniary sacrifice when the children of a family are rachitic.

The *diet* in rachitis should receive particular attention, since indigestion and gastro-intestinal derangement sustain a causative relation to so many cases. Good breast-milk ought, if possible, to be obtained until the child has reached the age of ten months, and, if the mother's condition be such that she cannot furnish it, a wet-nurse should, if practicable, be employed. But after the age of six months additional nutriment is required. As a rule, the infant should be weaned at the age of twelve months, but longer nursing may be best under certain conditions, as the presence of hot weather, an abundant supply of good breast-milk, and, on the part of the infant, feeble digestion and easily deranged digestive organs. In case breast-milk cannot be obtained, cow's milk, properly diluted, according to the age, with water, or with a farinaceous solution is the best substitute. The reader is referred to the chapter relating to the diet of infancy, for full particulars relating to infant feeding. For infants with feeble digestion, it is better that the starch should be converted into glucose before its use, by Liebig's or a similar process. Four teaspoonfuls of barley, rice, or wheat flour, or of oatmeal, may be mixed with a pint of water, and boiled with constant stirring, five to ten minutes, when it is removed from the fire, and cooled to a blood heat. One teaspoonful of Trommer's malt for infants, Reid & Carnick's, or other good preparation of malt, should be added to this. This process thins the starch, and renders it more digestible. The gruel thus prepared should be mixed with cow's milk, in varying proportion according to the age of the infant. It is probably best in the use of most of the farinaceous substances, and particularly of barley, to grind in a coffee-mill the whole kernel, and make

the decoction from the husk, in or close to which the nitrogenous products abound, as well as from the interior of the seed, in which the starch abounds (Jacobi), and from which the barley flour of the shops is prepared. The decoction should be strained through a sieve before adding the milk. The importance of obtaining cow's milk of the best quality for the rachitic, need not be dwelt upon in this connection. In hot weather in the cities, it is usually best to scald it as soon as received, and perhaps different times during the day, to prevent fermentation, for sour milk should never be used.

Meat soups properly prepared according to the age, are useful additions to the diet. I have elsewhere stated that in one of the institutions of New York, rachitis from being common was made to disappear almost entirely, by allowing a more generous diet, a part of which was the daily use of a little beef-tea. I have employed with apparently good results, beef-tea prepared as follows: Add half a pound of finely hashed beef to one pint of cold water, mix with it ten drops of dilute muriatic acid, allow it to stand cold with frequent stirring half an hour, then place it upon the table in a pail or large pan of boiling water, so as to heat it without coagulating the albumen. In an hour it is ready for use. The peptonized beef of the shops, as now prepared by Parke, Davis & Co., according to Rudisch's method is also a most useful preparation.

Medicines which improve the general health are all more or less beneficial in the treatment of rachitis, but lime and cod-liver oil are especially indicated. The following formula will be found useful in most cases:

℞.—Olei morrhuæ . . . . . f℥iv.
Aq. calcis,
Syr. calcis lactophosphatis . . . . āā f℥ij.—Misce.

Of this, one teaspoonful should be given four or five times daily to an infant of one year. This combination agrees with the digestive function, and is readily taken by most infants. Cod-liver oil, while it improves the general nutrition, is especially useful in rachitis.

Care should be taken to prevent deformities while the bones are soft and yielding. The patient should not be encouraged to stand or use the limbs until they become firmer. He should lie upon an even and soft mattress, and should be taken into the open air in a carriage. A uniform support of body and limbs is requisite in order to prevent curvature.

In craniotabes the pillows should be soft, and care should be taken that the yielding parts of the cranium should not be unduly pressed upon. The perspirations may be relieved by sponging with vinegar and water. The infant should be regularly bathed in water a little cooler than the body, and rock salt may be added to the bath. The proper treatment of laryngismus stridulus, which so frequently complicates rachitis, is described in our remarks upon that disease. Constipation, common in the rachitic, should be treated by simple enemata, except so far as it can be relieved by change in the diet. When curvatures are unavoidable, orthopædic treatment will subsequently be required.

Such is an outline of the treatment which rachitis ordinarily requires,

but other medicinal agents may be found useful for their general tonic action, or by supplying lime-salts to the system; among which may be mentioned, the compound syrup of the phosphates, the citrate of iron and quinia, wine of iron, the various preparations of cinchona, columbo, etc. Flieschmann recommends the fluorine compounds in order to increase and harden the enamel of the teeth, employing for the purpose the tooth pastille of Ehrhardt or Hunter, which contains the flouride of potassium.

CHAPTER II.

SCROFULA.

The term scrofula (*scrofa*, a pig, from the resemblance of the enlarged cervical glands of a scrofulous individual to a swine's neck) is applied to a diathesis which is characterized by increased vulnerability of the tissues. The nutritive process of the tissues is readily disturbed even by trifling irritants or agencies in those who have this diathesis, and, therefore, the scrofulous are prone to inflammations of various parts. Inflammations, which can properly be considered as dependent upon this diathesis, or as occurring under its influence, are for the most part subacute or chronic, and they differ from ordinary inflammations in the fact of a greater cell-formation, and greater liability to cheesy degeneration of inflammatory products, so that return to the healthy state by absorption is slow or impossible. Moreover, this diathesis, while it gives rise to certain inflammations, which do not occur or are rare in other states of the system, and which all physicians at once recognize as scrofulous, often modifies those common inflammations to which all persons, whether scrofulous or non-scrofulous, are liable, as coryza and bronchitis, rendering them more protracted and less amenable to ordinary treatment.

Scrofula is a disease chiefly of infancy and childhood. Manhood, especially the first years of it, is not entirely exempt, but scrofulous manifestations after the age of twenty years are feeble and infrequent, disappearing entirely as the individual advances towards middle life. The diathesis is most active prior to the age of ten years.

Causes.—Scrofula is congenital or acquired. Parents who had scrofulous symptoms in early life, or who are in a state of decided cachexia, as from cancer, syphilis, intermittent fever, or tuberculosis, are apt to beget scrofulous children. Insufficient nourishment of the mother during a considerable part of her gestation, and advanced age, and therefore feebleness, of the father, are occasional causes. Near blood relationship of the parents is also a recognized cause, and to this has been attributed the scrofula of royal families. Children whose father and mother are first cousins are, according to my observations, likely to be scrofulous.

Again, those born with sound constitutions may acquire scrofula through antihygienic influences in the first years of life. Among the poor of New York we often observe one child in the family who presents scrofulous symptoms, while the rest of the children are well, and in many cases we are able to trace back the diathesis to some depressing cause or causes, which were sufficient to effect the peculiar change in the molecular condition of the tissues which constitutes this disease. Obviously the causes of acquired scrofula are quite numerous. In the infant it is sometimes produced by insufficiency or poor quality of the breast-milk, or the use of artificial food during the period when breast-milk is required. Too protracted lactation also, especially if artificial food be almost wholly withheld, may cause it; as may also, in those who have passed beyond the age of lactation, the continued use of a diet which is deficient in nutritive properties.

Residence in damp, dark, and filthy apartments or streets may also produce it. Hence one reason of its frequent occurrence among the city poor. Residence in a small, crowded, and imperfectly ventilated apartment has been known to produce it, even with personal cleanliness, and a diet sufficiently nutritive.

Scrofula may also be caused, in those previously robust and of sound constitution, by disease of an exhausting nature. The eruptive fevers, as smallpox, measles, and scarlet fever, if severe, occasionally produce this result; or they render active the diathesis, which had hitherto been latent. In this city, where chronic entero-colitis of infancy is common, I have sometimes been able to trace the diathesis to the cachectic state and the impaired nutrition which it causes.

There is probably no specific principle in scrofula, and therefore it is not infectious. In those exceptional instances in which scrofulous symptoms appeared after vaccination in those previously healthy, it is probable that there were other more potent coöperating causes than vaccinia. That vaccination may communicate syphilis and erysipelas, has been shown by many observations. But while these diseases result from the reception into the system of certain poisons peculiar to them; scrofula as certainly results from a variety of depressing agencies affecting the system in many distinct ways, with the general result of impairing its vigor and lowering its tone. It seems, therefore, unreasonable to suppose that these many and distinct agencies introduce a fixed specific principle into the system, which causes the phenomena of scrofula. If there be surroundings of a decidedly antihygienic character, or if there be an inherited predisposition from cachectic parents, the ordinary diseases of childhood, especially if severe and protracted, as scarlet fever, measles, pertussis, and even vaccinia (Henoch), may be sufficient to cause this constitutional anomaly.

The primary scrofulous ailments, by which the diathesis is manifested, occur for the most part upon one of the free surfaces, namely, upon some part of the skin or mucous membrane. Certain standard authors attribute this to the fact that these parts are most exposed to the action of noxious agencies. The lymphatics lying in the inflamed area take up the altered lymph and carry it to the adjacent lymphatic glands, which become irritated, and undergo hyperplasia, and perhaps ulti-

mately suppuration. This is, in a large proportion of cases, the beginning of scrofulous ailments. Nevertheless, in not a few instances, the first manifestations are in deep-seated and covered parts, as when scrofulous periostitis or osteitis occurs, without any peripheral lesion.

Anatomical Characters.—There are no ascertained anatomical changes in the blood which are peculiar to scrofula. As long as the appetite and general health remain good, and the local affections have not occurred, the composition of this fluid is, so far as known, unaltered. In the cachexia which is present when the general health is impaired, the blood becomes impoverished, the red corpuscles lose a portion of their coloring matter, and the watery element predominates.

The question arises whether the glandular hyperplasia of scrofula produces an excess of white corpuscles in the blood. Virchow says: "During the progress of an attack of scrofula, in which, if the disease run a somewhat unfavorable course, the glands are destroyed by ulceration, or cheesy thickening, calcification, etc., an increased introduction of corpuscles into the blood can only take place as long as the irritated gland is still, in some degree, capable of performing its functions, or still continues to exist; as soon, however, as the glands are withered or destroyed, the formation of lymph-cells likewise ceases, and with it the leucocytosis. In all cases, on the other hand, in which a more acute form of disturbance prevails, connected with inflammatory tumefaction of the gland, an increase of the colorless corpuscles always takes place in the blood." (*Cellul. Pathol.*) Although the glandular hyperplasia occurring in scrofula increases the number of white corpuscles in the blood, scrofula cannot be regarded as sustaining any causative relation to that great and constant increase of white corpuscles which characterizes the disease leucæmia; for this disease, as remarked by Niemeyer, does not occur in childhood, when the scrofulous diathesis is active, but in manhood, when it has ceased to exist, or has become latent.

Strumous inflammations of the cutaneous and mucous surfaces, which we have seen are the initial lesions in a large proportion of scrofulous cases, do not present any peculiar anatomical characters. Some of them are attended by an abundant formation of cells, and by dense infiltration of the inflamed tissues; but inflammations which do not depend on the strumous diathesis have the same anatomical elements. The most marked differences between the strumous and non-strumous inflammations are found in their origin, amount of cell-formation, and duration.

The swelling of the lymphatic glands, which is so common in the neighborhood of scrofulous ailments, and which we have seen is in most instances the result of "conducted irritation," is due to hyperplasia of the lymph-cells with comparatively little or no increase of the stroma. Thus hyperplasia of the cervical glands is common, resulting from eczema of the scalp or face, or from otitis, or any of the forms of stomatitis; and so pharyngitis often gives rise to hyperplasia of the tonsils, which are lymphatic glands. The scrofulous nature of the glandular enlargement is apparent from the fact that it continues long after the primary inflammation which gave rise to it has abated. Lymphatic glands sometimes enlarge in those who are not scrofulous, either from

direct injury or propagated inflammation, but the tumefaction is commonly less in degree, and in most instances it soon abates when the exciting cause is removed.

The glands which most commonly undergo scrofulous enlargement are the cervical, inguinal, bronchial, and mesenteric; but in those who are decidedly scrofulous, the glands in the vicinity of any protracted inflammation are very prone to hyperplasia. Thus I have seen enlarged and cheesy glands in the vicinity of scrofulous ostitis, or periostitis.

Under favorable circumstances the glandular enlargement abates after a short time, by absorption of the redundant cells. But the products of hyperplastic or inflammatory action in the scrofulous individual are very liable to undergo cheesy degeneration, and the close causative relation of this cheesy substance with tubercles is now admitted. If resolution do not soon occur in the gland, it begins to undergo cheesy degeneration. It becomes firm and inelastic, its nutrient vessels narrowed and compressed, so that circulation through it ceases, and its cells, losing their liquid and vitality, shrivel away. This necrobiotic process appears in points in the gland, which enlarge and unite, till finally the whole gland becomes a dead mass, with shrivelled elements, of a whitish appearance, like cheese, the resemblance to which has suggested the name by which the degeneration is known.

In certain patients cheesy glands act as an irritant, like inorganic matter, producing suppurative inflammation, and their subsequent history is that of an abscess. Purulent matter mixed with the cheesy débris escapes by ulceration upon the nearest surface, and scrofulous ulcers result, which slowly heal, leaving permanent cicatrices; calcification of a cheesy gland occurs in exceptional instances.

The cervical lymphatic glands in the scrofulous child, having undergone hyperplasia of their cellular elements, not infrequently continue painless and indolent for a considerable time, producing, according to their size, an unsightly appearance, and without undergoing cheesy degeneration. Finally one or more become inflamed, and the broken-down gland substance softens and is expelled, mixed with pus, through an ulcerated opening in the skin.

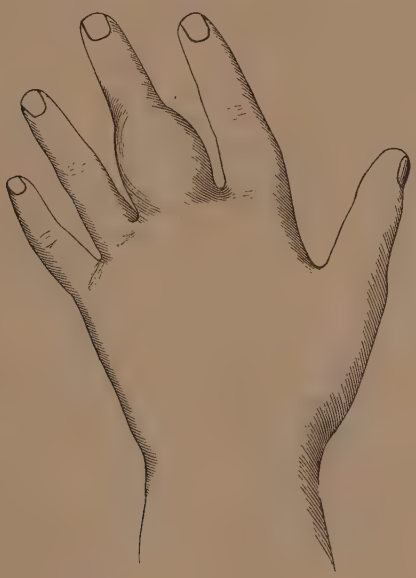
In order to complete the description of the anatomical character of scrofula, it would be necessary to describe the various inflammations to which the diathesis gives rise. Those which are most common and important occur in the skin, mucous membrane, connective tissue, the joints, the bones with their periosteal covering, and the eye and ear; eczema and coryza are very common scrofulous ailments. Phlyctenular keratitis with great intolerance of light, otitis externa, causing protracted otorrhœa, or media and interna, causing deep-seated pain, with impairment or loss of hearing, offensive purulent discharge, and, in the gravest cases, caries of the mastoid cells or caries extending along the petrous portion of the temporal bone even to the brain, causing meningitis and death, are not uncommon manifestations of scrofula, in the families of the city poor. Strumous cellulitis, occurring independently of the glandular affection, and quickly ending in suppuration, is also common. The term *cold* is applied to the abscess when the local symptoms are slight, and there is but little heat of the parts. In young

children the common seat of these abscesses is directly under the skin, so that if subcutaneous cellulitis running into an abscess occur in a young child, he probably has the strumous diathesis.

The osseous system is very prone to inflammation in the scrofulous. Periostitis, ostitis, and arthritis, rare in those with healthy constitutions, are common in the scrofulous, in whom they result, even from very slight injuries, and sometimes without the recollection of any injury, and apparently from the direct influence of the diathesis. These inflammations are more common in the lower extremities than in the upper. Periostitis often occurs in scrofulous children without ostitis, when its usual seat is upon the shafts of the long bones, and it also accompanies inflammations of the bone, as pleurisy accompanies pneumonia. The osseous inflammations of strumous patients are of two kinds: first, the destructive, producing caries with suppuration, or necrosis; and, secondly, the so-called *fungous*, in which there is proliferation of tissue as in white swelling. Often both these processes coexist, granulations and new tissue springing up, while the carious or necrotic process is extending.

Dactylitis is in most instances, when occurring in young infants, a syphilitic affection, but in children of one year or more, in whom no marked syphilitic symptoms have previously occurred, it originates from

FIG. 18.



the strumous cachexia, as in the following case: Charles R., aged twenty months, was admitted into the New York Infant Asylum in 1876. He had always been pallid, and had a strumous aspect. A physician acquainted with his parentage states positively that he is free from syphilitic taint, but when a few months old he had a mild form of

coryza, which gradually abated under anti-strumous treatment. At the age of five months he had purpura hemorrhagica of a severe form, but apparently not accompanied by hemorrhage from any of the mucous surfaces. The patches of extravasated blood were quite numerous and large over the trunk and limbs, and it was nearly three months before they entirely disappeared. A few months subsequently he began to have offensive otorrhœa on one side, which did not entirely cease. In December, 1876, at the age of eighteen months, well-marked dactylitis was first observed, involving the first phalanx of the left middle finger. The swelling was somewhat tender, and the skin which covered it had a slightly reddish or pinkish tinge, indicating the inflammatory nature of the malady. Neither joint at the extremity of the phalanx was involved, so that the movements were unimpaired. The dactylitis increased somewhat after it was first discovered, and then began to decline, under treatment with cod-liver oil and syrup of iodide of iron. The accompanying woodcut represents the outlines, obtained by tracing the hand of the infant, when pressed on paper.

Symptoms.—The scrofulous diathesis is exhibited by certain physical signs, which are present in infancy, but are more manifest in childhood. In one class of strumous children they are as follows: form, tall and slender; quickness of movement and perception; intelligence, good; skin, thin and semi-transparent, through which the superficial veins are distinctly seen; features, delicate; cheeks, habitually pallid or florid, and flushed by slight excitement; eyes, bright, with bluish conjunctiva; muscles and bones, slender in proportion to their length. Those children who present these peculiarities are said to have the erethitic form of the diathesis.

Others have what has been designated the torpid scrofulous habit, which is characterized by softness and flabbiness of the flesh, distended abdomen, large head, broad face, slow, languid movements, and an overproduction of fat in the subcutaneous connective tissue in certain situations, especially the nose and upper lip. Though typical cases can be readily referred to one or the other of these forms, there are many which are intermediate.

One of the earliest of the scrofulous manifestations is subcutaneous cellulitis, alluded to above, giving rise to abscesses, commonly not large, with little surrounding induration, little pain, tenderness, and heat, and slow in discharging; in a word, indolent. The most frequent seat of these abscesses is upon the extremities, but they may occur upon the scalp or elsewhere. They gradually heal when the pus escapes, their site being indicated for a considerable time by the depression and reddish discoloration of the skin, which gradually returns to its normal state. Ordinarily, these abscesses do no harm apart from the reduction of the general health which they effect, but, when occurring in localities where the connective tissue lies upon the periosteum, as upon the fingers, periostitis may result, with destruction of the surface of the bone. Again, thrombi may occur in the vessels of the inflamed part, giving rise to emboli, embolismal pneumonia, and death. Specimens from such a case were presented by me to the New York Pathological Society in 1868.

The scrofulous affections of the skin often also occur at an early age, even before dentition. They are more frequent in infancy than in childhood. The most common are eczema and impetigo, and, of rare occurrence, ecthyma and lupus. But all these may occur in those who are not strumous or who do not present the characteristics of the strumous diathesis.

Scrofulous affections of the mucous surfaces are scarcely less frequent than those of the skin. They present the ordinary features of mucous inflammations of a subacute and chronic character.

Sometimes they occur without obvious exciting cause; in other cases there is a cause of this kind, such as exposure to cold; but the inflammation, once established, continues on account of the diathesis. It is often doubtful whether inflammations in strumous subjects be of such a character that it is proper to designate them strumous, especially if they occur upon such surfaces as are frequently the seat of ordinary inflammation. If the child have heretofore presented symptoms of scrofula, if the inflammation be subacute, and there be no apparent cause to originate or sustain it apart from the diathesis, it is probably of a strumous character. The diagnosis is rendered more certain by observing the effect of anti-strumous remedies. The most frequent of these scrofulous inflammations of mucous surfaces are coryza, tracheo-bronchitis, and conjunctivitis. More rarely, stomatitis, pharyngitis, vaginitis, and, according to some, entero-colitis, are of a strumous character. Coryza gives rise to snuffling respiration, the formation of crusts around and within the nares, and excoriation of the upper lip. The tracheo-bronchitis is attended by thickening of the mucous membrane, increased production of mucus and epithelial cells, and a loud tracheal râle, accompanying each inspiration.

Strumous inflammation of the mucous membrane of the trachea and bronchial tubes is not a very infrequent disease in this city. It sometimes originates in a simple inflammation from cold, or the tracheo-bronchitis of measles, or pertussis, and it is apt to continue, with its râles, cough, and scanty expectoration, for months, unless relieved by a proper course of treatment.

Among the most common of the strumous affections, are inflammation of the eyelid, designated psorophthalmia, and that of the eye itself. The former is characterized by redness and thickening of the lids, detachment of the eyelashes, and inflammation and altered secretion of the "Meibomian glands;" the latter, namely, strumous ophthalmia, by pain, lachrymation, photophobia, and a moderate degree of hyperæmia of the affected organ. One of the most common serious results of strumous inflammation affecting the eye, arises from the conjunctivitis and keratitis, namely, the formation of phlyctenulæ and ulcers on the margin of the conjunctiva and upon the cornea, fed by newly formed vessels. If not controlled by proper treatment, these may result in opacities more or less permanent, or possibly, worse still, in perforation, with its consequent ill-effects.

Inflammations of the external and middle ear have their origin very generally in the strumous diathesis. Occasionally there is an exciting cause of the otitis, as an injury, or severe constitutional disease, like

scarlet fever. Protracted otitis, whether external or internal, and especially that form of it which leads to ulceration, destruction of the ossicles, and caries of the petrous portion of the temporal bone, it is proper, in a large proportion of cases, to regard and treat as strumous.

The stubbornness and frequent disastrous consequences of scrofulous inflammation of the skeleton are well known. Nearly every bone, as well as its periosteum, is liable to this form of inflammation, but some are more frequently affected than others. Inflammation of the bone may terminate by resolution, by the formation of an abscess, or, and frequently, by carious or necrotic destruction of the bone itself. Necrosis is most apt to occur in the shafts of the long bones, caries in the spongy extremities of these bones, and in the spongy portions of the short bones. If abscesses form, the pus may finally escape from the system by a tedious ulcerative process, or, retained, may undergo cheesy degeneration. Scrofulous arthritis, if early detected and properly treated, may resolve, leaving no ill-effect; if otherwise, suppuration, ulceration, cartilaginous and osseous, and ankylosis, often occur.

Scrofulous children are perhaps no more liable to inflammation of the internal organs than other children, but the inflammatory products are more liable to cheesy degeneration, and the prognosis is, therefore, less favorable. The most frequent of these inflammations, and the one of chief interest, is pneumonia. Catarrhal pneumonia, so frequent in early life, whether primary or secondary, in connection with measles, pertussis, etc., is a disease often involving grave consequences in those who are decidedly scrofulous; since, instead of resolving, the affected lung-tissue presents a strong tendency to caseous degeneration ending in consumption of the lungs and death. I have most frequently noticed cheesy pneumonia during extensive epidemics of measles, as a complication or sequel of this disease. It may occur in those who are not scrofulous, if the vital powers be greatly reduced, but it is so much more common in the scrofulous, that some recent writers have designated this form of inflammation by the term of scrofulous, instead of cheesy, pneumonia. From the fact, however, of its sometimes occurring in the non-scrofulous, the term cheesy or caseous, especially, too, as it expresses the anatomical state, seems more appropriate.

The caseous substance which so frequently results from degeneration of the products of scrofulous inflammations, affords a nidus in which the tubercle bacillus frequently obtains lodgement, and conditions favorable for its propagation. Hence the close etiological relations of scrofula or scrofulous inflammations to tuberculosis.

Prognosis.—As scrofula may be acquired through antihygienic influences, so it may disappear or become latent through influences of an opposite character. Therefore the manifestations of scrofula may be limited to a brief period, or they may occur at intervals through the whole of childhood, and the first years of youth. When the diathesis is inherited, and fostered by unfavorable circumstances, the scrofulous affections appear earliest, are most varied and severe, and continue longest.

In most cases, with proper treatment, the prognosis is good, but the danger to life depends on the nature and extent of the scrofulous inflammation. The most common unfavorable result is the occurrence of

pulmonary or general tuberculosis from the infection supplied by the cheesy substance, in the manner stated above. This is the usual result from cheesy pneumonia. The next most common cause of death, either directly or indirectly, is inflammation of the osseous system. Many deaths occur from inflammation of the vertebræ, or of the hip or knee-joint, when it has been allowed to continue a considerable time without proper treatment. Protracted suppurative inflammation of the bones is apt to produce amyloid degeneration of organs, which is permanent, and likely to prove fatal, or death may occur from exhaustion, with or without tuberculosis. Among the city poor meningitis is not very uncommon, consequent on long-continued otitis media and caries of the petrous portion of the temporal bone. Permanent impairment of sight and hearing often results from neglected strumous ophthalmia and otitis.

At puberty the strumous affections gradually become less frequent, and they finally disappear in advancing age. Among the most robust adults are some who in early life presented indubitable symptoms of the strumous diathesis.

TREATMENT. *Prophylactic.*—Measures designed to prevent scrofula are impossible without the coöperation of willing and intelligent parents. It is obvious that the prevention of congenital scrofula requires the treatment of disease or impaired health in the parent. If parents should be taught, or should remember, that good health in themselves is the necessary condition of the inheritance of a sound constitution in the child, and would adopt such therapeutic and regimenal measures as would procure this, the number of cases of inherited scrofula would be materially reduced.

As the first years of life are very important, both for correcting the diathesis when inherited, and for preventing its development in those of sound constitution, care should be taken that the regimen of the child be such that it does not produce deterioration of the general health. The nursing infant, if the mother be in poor health, should be provided with a healthy wet-nurse, for in young children the diathesis may be acquired solely by the use of food that is scanty or of poor quality. Those old enough to be weaned should have plain and nutritious diet, with a proper admixture of animal food. More or less out-door exercise, and residence in a salubrious locality, with sufficient air and sunlight, are also requisite.

Curative—Since scrofula originates in a state of weakness existing in the parent in the congenital, and in the child in the acquired form of the disease, and is characterized by feeble resistance of the tissues to irritating agents, the inference is reasonable that all tonics have, to a certain extent, an anti-scrofulous effect upon the system. The ordinary vegetable tonics, and sometimes the ferruginous, are indeed useful in the treatment of scrofula. Employed in connection with proper regimenal measures they are sufficient, in many cases, to remove the diathesis after a time, or render it latent. Besides these medicinal agents, which tend to correct the scrofulous diathesis by their general tonic effect, there are certain others which experience has shown to be beneficial in the treatment of scrofulous affections, and which are, therefore,

largely used. One of these is cod-liver oil, which contains iodine among its many ingredients.

Cod-liver oil is useless, or nearly so, in the torpid form of the diathesis, which is characterized by an increased deposit of fat in the subcutaneous connective tissue, slow circulation, and sluggish muscular movements. On the other hand, in the treatment of the erethitic form it possesses real value. Its protracted use in such cases does so modify the molecular condition of the tissues that they are less liable to inflammation, and the diathesis is, therefore, rendered milder or removed. From one to three teaspoonfuls, according to the age, should be given three times daily. While we frequently experience so much difficulty in administering it to adults affected with tuberculosis, and sometimes find it necessary to discontinue its use on account of its nauseating effect, scrofulous children rarely refuse to take it, and it does not seem to diminish their appetite.

Iodine is justly celebrated as a remedy in the treatment of scrofulous maladies, but it is a question whether it has not been overrated as a remedy for the diathesis itself. Iodine employed internally is especially serviceable in glandular hyperplasia, and in scrofulous thickening and induration of the connective tissue and periosteum. In general, it should not be administered to children in its isolated state, on account of its irritating properties, but one of its compounds should be employed. The compounds which are chiefly prescribed in the treatment of scrofula are the iodides of starch, iron, potassium, and sodium. If, as is frequently the case, the patient be pallid, and his appetite poor, the iodide of iron should be preferred; if not in this cachectic state, the iodide of starch may be used. Pharmaceutists prepare syrups of both these iodides, so that they can be readily administered to the youngest child. The iodide of starch may be administered by dropping from one to five drops of the officinal tincture of iodine on a little powdered starch, and giving it in syrup. These iodides are preferable to the iodides of potassium and sodium for internal administration to children, as they are not irritating to the mucous membrane, and the iodine is readily set free. Prof. Dalton has, indeed, demonstrated that the iodide of starch is decomposed in most of the liquids of the body, and the iodine liberated.

In New York City a large proportion of the scrofulous children are cachectic, and need iron, and the iodide of iron is more frequently employed, and with good results, than any other iodine compound. The syrup of the iodide of iron, which is readily absorbed, should be given in one to two-drop doses three times daily to a child of six months, and one additional drop added for each additional year. Among the vaunted remedies of scrofula are phosphoric acid and the phosphate of lime. I have not employed these agents without at the same time using other remedies, and cannot say, therefore, to what extent they have been curative in my practice. Probably there is no better combination of remedies for the strumous diathesis than the following, which is now used in some of the institutions of New York, and which we have already recommended in the treatment of rachitis.

R.—Ol. morrhuæ	2 parts.
Syr. calcis lactophosphat.	1 part.
Aquæ calcis	1 part.—Misce.

Dose, one teaspoonful to a dessertspoonful three or four times daily, to each dose of which, the syrup of the iodide of iron may be added.

The internal use of mercury as an antidote for scrofula is now generally discarded. Unless, perhaps, in those cases in which the diathesis is immediately dependent on syphilis, its use for this purpose, from what we know of its therapeutic effects, would probably be more injurious than beneficial. Among the medicines which have from time to time been employed for the cure of scrofula, some of which have had considerable reputation but have nearly fallen into disuse, are walnut leaves, sarsaparilla, elecampane, conium, digitalis, horseradish, compounds of silver, gold, arsenic, baryta, and bromine. It is probable that none of these has any effect on scrofula or scrofulous ailments, except such as improve the appetite and general health, as horseradish.

The same hygienic measures are required in the treatment of scrofula which are employed in the prophylaxis of it. The nursing infant should have healthy breast-milk, and if its mother belong to a tubercular or scrofulous family, or be feeble, a healthy wet-nurse should be employed, or it should be sent to the country, where suitable cow's milk as well as pure air can be obtained. The expressed juice of beef slightly boiled, the peptonized beef, or beef-tea prepared as recommended for rachitic infants, given several times daily in small quantity to infants, aids materially in restoring a better nutrition of the tissues. Obviously, similar care is necessary in the selection and preparation of the food of children who have passed beyond the period of infancy. While the diet should be highly nutritious, it should be plain and easily digested, and given at sufficient intervals, so as not to overtax digestion.

Fresh air, out-door exercise, daily bathing, personal and domiciliary cleanliness, are very necessary for the successful treatment of the diathesis. Since scrofula is comparatively infrequent in farming sections, scrofulous families are greatly benefited by farm life, with all the accessories to health which pertain to it.

The local scrofulous ailments require additional and special treatment. Those located on the cutaneous and mucous surfaces are less dangerous, as a rule, than the deeper seated inflammations; still they should be promptly treated, not only for the inconvenience and annoyance which they cause, but because they are apt to lead to hyperplasia of the neighboring glands, which sometimes proves serious. Thus pharyngitis may cause a peripharyngeal adenitis and abscess, and a bronchitis may cause adenitis of the bronchial glands, with the probability of their cheesy degeneration. The so-called bronchial phthisis is believed to result, in a large proportion of cases, from a strumous bronchitis which has been allowed to run on uncontrolled by medicine, and a similar state of the mesenteric glands may result from intestinal catarrh. Inflammation of the skin or mucous surface occurring in the strumous, requires the continued use of antistrumous remedies, conjoined with such treatment, designed to act locally, as is appropriate for the case.

It is the common practice to treat the enlarged glands of struma by daily applications over them of the stronger iodine preparations. This treatment does not cause absorption of the redundant gland substance. It causes proliferation of the epidermic cells, and quickens the cell

change in the gland underneath, so that leucocytes are liable to form in it. Cutaneous inflammation, as eczema or impetigo, causes hyperplasia of the lymphatic glands underneath. In like manner strong applications, which irritate the skin, are apt to quicken the cell formation, so that suppuration is a common result. I once produced accidentally such an amount of vesication over an enlarged, hard, and apparently indolent gland in an infant of fourteen months, that I was very anxious lest a sore would result, which would heal with difficulty, and yet instead of dispersion of the glandular swelling the pathological processes were so promoted that suppuration and discharge of pus occurred by the time that the cuticle had reformed.

We know no better substance for the local treatment of strumous adenitis than iodine, and it should be applied, in my opinion, in such a manner that it is absorbed with the least possible irritation of the gland. The following will be found useful ointments and solutions for the treatment of these cases:

℞.—Potas. iodidi . . . . . ʒj.
Ung. stramonii . . . . . ʒj.

To be rubbed over the gland several times daily. It should not be applied as a plaster, as it is too irritating and will vesicate. I have known a glandular swelling, which had continued about three months, to disappear in three weeks under its use in connection with internal remedies. Vaseline, in place of the stramonium ointment, makes a nicer preparation. Another useful iodine mixture for these cases is the following:

℞.—Liq. iodinii composita,
Glycerinæ, equal parts.

To be applied as an inunction. Glycerine renders the skin soft and in a state favorable for absorption.

In *The Medical Press and Circular* for August 3, 1870, J. Waring Curran states that he has used with great success what he designates a new iodine paint, consisting of half an ounce of iodine, the same quantity of iodide of ammonium, twenty ounces of rectified spirits, and four ounces of glycerine.

Mercurial ointments have been recommended by writers of reputation for the treatment of these glands. I have employed them, and known them to be employed, but cannot say that I have ever observed any benefit whatever from their use. In the children's class at the Out-door Department at Bellevue we have discarded them entirely for this purpose, although both the citrine and white precipitate ointments, diluted with an equal quantity of lard, have been used with apparent benefit for chronic coryza of a strumous nature, and also occasionally for external otitis of the same nature.

In a paper read at the meeting of the British Medical Association in 1870, by Mr. Jordan, the writer recommends, as attended with success, vesication, not over the gland, but at a little distance from it, as, for example, behind the neck, for treatment of the cervical glands. But a mode of treatment which seems so unlikely to be beneficial requires stronger proof of its utility than has yet been presented.

A very important adjuvant to the external use of iodine over an inflamed gland is the constant application of cold. A small India-rubber bag containing ice, or muslin frequently wrung out of ice-water and applied over the gland, contracts the vessels, diminishes the activity of the morbid process going on underneath, and aids materially in the resolution. When the gland becomes so actively inflamed, or the inflammation so advanced that redness of the skin occurs, applications of iodine are no longer proper. They increase the local disease. There is no longer any probability of resolution of the gland, and poultices should be applied.

It is important that the diseases of the osseous system should receive early treatment, but, unfortunately, it is in reference to these inflammations that error of diagnosis is frequently made. Thus I have known periostitis, with the diffused redness of the skin and heat which it produces, to be mistaken for erysipelas, until the diagnosis was corrected from its persistence and non-extension. It is remarkable that strumous arthritis sometimes appears in two or more joints at once, as in the case related below. I have known it to occur nearly simultaneously in three joints, though only for a brief time in two of the joints, while it was chronic in the other. Hence, the fact that this inflammation is often mistaken for inflammatory rheumatism, and treated as such for some days, till its nature becomes apparent; and in like manner the febrile movement, lassitude, abdominal pain, etc., of vertebral caries are in a large proportion of cases attributed to something else, and the true disease not suspected till irreparable damage has occurred, or much longer confinement and treatment required than would have been necessary with an earlier diagnosis.

Fig. 19.

The common strumous inflammations of the osseous system which involve the joints, as Pott's disease, hip-disease, and white swelling, are usually quite amenable to treatment, early applied, which insures complete rest; but, as a rule, cases neglected, or wrongly treated, go from bad to worse. There are exceptions, for a case may do well or terminate with moderate deformity without treatment, as in the following interesting instance, which also shows the difficulty which often attends diagnosis:

Anna D., aged six years, came to the children's class in the Out-door Department at Bellevue in February, 1877, with the following history: Her health was good till two years ago, when she complained of pain of a mild form in both knees. Her parents attributed it to her rapid growth, and she was always able to walk with little suffering. Slowly but steadily these joints began to swell. She has had no pain in other joints, and no member of the family has had rheumatism except a grandparent. She walks without complaint to the rooms of

the Bureau. The affected joints are about equally swollen, and it is evident on examination that they contain some serous effusion. Direct pressure is not painful, but pressing the bones together with a twisting or rotating movement gives some pain. She is pale, and has a strumous aspect. A sister of fifteen years has a similar swelling of one knee, which began at the age of seven or eight years, but which has received no regular treatment, has not prevented the free use of the limb, and has given her little inconvenience.

The physicians who have examined this child, one of whom is an expert in orthopædic surgery, agree that the disease is strumous and not rheumatic, and that it did not, during two years of neglect and unrestrained motion, go on to suppuration and destruction of the joints, was probably due to her good general health.

Though the result in the above case was good, since there was little impairment in the use of the joints, and no suffering, yet delay and neglect in the treatment of those strumous inflammations which involve the joints are exceedingly dangerous, for if left to themselves they most frequently end in suppurative inflammation and ulceration, with all the sad consequences which these entail. Strumous inflammations of the osseous system now receive more early and correct treatment than formerly, and orthopædia, almost unknown till within the last twenty years, has become an important branch of surgery. Formerly in New York, especially in the tenement houses, we often met emaciated bed-ridden children with strumous osteitis and arthritis, their limbs swollen, and painful in motion, and offensive from the discharge, for the most part shunned by physicians, and with no prospect of relief except by amputation. Now this spectacle is comparatively infrequent. The early symptoms of these diseases being better understood and sooner recognized, the plaster of Paris or starch dressing to insure immobility, or ingeniously devised steel splints, which produce extension, and allow motion of the limb without friction of the inflamed surfaces, coming into general use, a large proportion of cases do not go beyond the first stage and are cured.

Strumous Ophthalmia.

(*Written by Dr. O. D. Pomeroy, Surgeon to the Manhattan Eye and Ear Hospital.*)

Strumous ophthalmia in young children, as described by the older writers, is simply a keratitis, or inflammation of the cornea, and is usually of the following varieties: phlyctenular or herpetic keratitis, and diffuse or parenchymatous keratitis. Perhaps it is a misnomer to designate these affections strumous. This general principle governs most cases of these inflammations, to wit, depressed vital energy, which of course is the prominent characteristic of the strumous diathesis. As is well known, the cornea is a tissue of low vital power and any constitutional state, accompanied by depression, predisposes to an attack of keratitis. One of the commonest hospital experiences is to see a mild case of catarrhal conjunctivitis, which should be self-limiting, gradually extend to the cornea, causing an ulcerative keratitis. I be-

lieve all ophthalmic surgeons hold that the presence of corneal disease, not dependent on an obvious or specific cause, points to diminished vitality on the part of the patient.

Herpetic or phlyctenular keratitis is the most frequent variety of corneal disease in children. It is a question whether it commences with a vesicle on the cornea, or a papule; but in either case it soon becomes an ulcer. Ciliary injection probably precedes it, though this can by no means be always observed. In some patients the characteristic symptom, to wit, photophobia, may exist for a long time without injection of the eyeball, or any corneal changes whatever, but sooner or later it is probable that other characteristic signs of the disease will make their appearance. The photophobia is frequently accompanied by blepharospasm, making it well-nigh impossible to separate the eyelids. When, however, this is accomplished, abundant tears gush forth, the child exhibiting signs of extreme distress. When the vesicle or papule is in a state of ulceration in the earlier stage, there may only be seen a minute loss of corneal tissue, without any opacity whatever. Soon, however, the ulcer becomes more or less opaque, perhaps seeming to be only a minute whitish spot on the cornea. This usually shows the commencement of reparative action. If the disease continue long a general conjunctivitis sets in, more especially of the ocular conjunctiva. Frequently there will be only one or not more than two or three ulcers, but, in exceptional cases, the cornea may have the periphery studded with phlyctenulæ, which, instead of promptly healing, proliferate so as to form elevated nodules, the so-called "scrofulous nodular bands." If the ulcer in any case continue long, a number of bloodvessels shoot out from the conjunctival border of the cornea, quite up to the ulcer, producing what may be termed *a vascular keratitis*. The discharge from the eye is often very acrid, causing catarrh of the lachrymal ducts, and even of the nares. Herpetic or eczematous eruptions on the cheeks, or the lip near the nostrils, are often seen, and may sometimes appear to be the cause of the disease rather than the effect. In this condition the upper lip may swell considerably, giving the patient a very "strumous" look.

The duration of phlyctenular keratitis is exceedingly variable; two or three weeks may bring it to a close, or it may continue many months. The condition of the constitution probably determines its duration as much as any other factor. Of course, if an ulcer perforate the cornea staphyloma may result, rendering recovery more tedious and incomplete. *The diagnosis* of this malady is not difficult. The photophobia so characteristic of keratitis, is present in no other disease except iritis, and the latter children rarely have; the little speck, spot, or abrasion on the cornea, together with the intolerance of light, is well-nigh diagnostic. Photophobia is present in most forms of corneal disease, though not in all. *The causes* of phlyctenular keratitis are about as follows: Any condition of the system known as strumous, or whatever tends to lower the vital powers of the patient, affords a predisposing cause. I am impressed with the idea that exposure to cold or sudden change of temperature is the common exciting cause, barring any cutaneous diseases which may pass from the skin to the eye. Naturally any cause

which produces a conjunctivitis may also produce this disease secondarily. The process of dentition may have something to do with the eye disturbance, or any disorder of the intestinal canal; the latter, however, being rather predisposing than exciting causes. This disease also frequently occurs in patients affected with aural or nasal catarrh, but the condition of such children trenches closely on the state designated "strumous."

The prognosis in a large number of cases is very favorable. The opacities of the cornea left after the healing of the ulcerations are the principal difficulties in the way of a good recovery. If the opacities are in the proper substance of the cornea, we are not certain that they will disappear by absorption, though they may. Nothing is more difficult than to determine this point. In the epithelial and Bowman's layers, as well as the posterior layer, opacities readily disappear. When the ulcer perforates the cornea we have an anterior synechia and the appearance known as *myocephalon*, which usually disfigures the eye more or less for life.

One discouraging point about these opacities is that, though they disappear, the cornea is left with a somewhat distorted curvature, causing irregular astigmatism, and if they chance to be near the centre of the cornea, great disturbance to vision results. I have often, in fitting spectacles, noticed that the patient's vision showed an unaccountable lowering, and on investigation have found a history of an infantile keratitis which had done all the mischief. In those cases described as having "scrofulous nodular bands," the proliferative nodules are very likely to undergo a variety of degenerations which do not end in a properly restored cornea. One great difficulty in making an exact statement here is the tendency of the keratitis to recur, and there is no knowing where the process will cease, after a number of recurrences.

Treatment.—As the fifth nerve presides over the ciliary vaso-motory system of the corneal nutritive supply, it is obvious that treatment calculated to correct any of its morbid manifestations would be rational. Such is found to be the fact. Sulphate of atropia, in from one to two grain solutions, dropped into the eye three times daily, is probably superior to any other treatment. It inclines to break up the orbicular spasms, relieving the photophobia and ciliary neuralgia, diminishes vascularity, and contributes more to the relief of the patient than any other one remedy. If the pain be severe the atropine may be used six or eight times daily, or even it may be instilled every fifteen or twenty minutes, until pain is relieved. If an over-effect be reached the patient complains of dryness in the throat, possibly pain in the head, or he may have other cerebral disturbances, when the drops may be discontinued for a time. Muriate of pilocarpine in two grain solutions may be used in a similar manner and for the same purpose; but it contracts the pupil and renders the accommodation tense, the very opposite to the atropine effect. I have not much confidence in this remedy. Powdered calomel may be dusted into the eye every second day. A small quantity only should be used, since it is apt to collect in masses, which act as foreign bodies (we desire to produce irritation for a few minutes only). A drachm of table salt to a pint of water may be used to bathe the eyes

freely four or five times a day, used warm or cold according to the patient's pleasure, though warm applications are more likely to be well received. Red precipitate ointment—℞. Vaseline, ℥j; hyd. ox. rub. in very fine powder, gr. j to ij. M.—placed under the eyelids every day or two, is often very beneficial. Occasionally the ulcers show a disinclination to heal, when they may be touched with Arg. nit., gr. x, aquæ dest., ℥j. M. Wind a bit of absorbent cotton on a probe, dip this into the solution, and touch the ulcer, but no other point. Cupri sulph., in ten grain solutions, may be used for the same purpose. A protective bandage exerting moderate pressure on the eye sometimes does good, but it should not feel uncomfortable. If there be much spasm of the orbicularis, however, it is not indicated. If the pain in the eye continue, and the orbicularis be in a state of spasm, a cantholysis may be done—that is, divide the external canthus so as to cause the lid no longer to press hardly upon the eyeball, and close the wound thus made by stitching the skin to the conjunctiva above and below the incision, and placing one stitch in the extreme outer canthus. This extends the length of the palpebral opening. The result of the operation is temporarily to break the power of the orbicularis, so as to arrest the spasm. This measure accomplishes in some cases what nothing else will.

If the eye be painful, without spasm of the lid, and there be great photophobia, whether the eyeball be too hard or not, paracentesis may be done. The mode of performance is described in the treatment of ophthalmia neonati in another place in this book. After a while the accompanying conjunctivitis may need treatment in the ordinary way. Indeed, astringents may often be used quite early to obviate the irritating effects which occasionally result from the use of atropine. If an ulcer refuse to heal after the treatment already laid down, iridectomy may be done, though this is not often resorted to. Occasionally an ulcer may be cut across, by passing a narrow Graefe's knife through it, making a puncture on one side and a counter-puncture on the opposite side, and then cutting out quite through the ulcer, dividing it into two equal halves. All needful treatment for the constitutional condition of the patient should be attended to. So necessary are fresh air and sunlight that I would never shut the patient in a dark room. Blue or smoke-colored glasses may be worn to protect the eyes from a strong light, and in some cases the eyes may be protected by a bandage of some dark material, so that the patient may be taken for an airing without suffering. I would, however, advise to accustom the eyes to the light as much as possible without causing pain.

In parenchymatous or diffuse keratitis we have quite a different array of symptoms. The margin of the cornea near the limbus may show a decided zone of injection of the conjunctival and episcleral vessels. It may be so excessive as to consist apparently of a rosy ring surrounding the cornea. These vessels after a time shoot inward, and may involve a large part, or even the whole of the cornea. In other cases, designated *non-vascular diffuse keratitis*, the injection is very slight indeed, and sometimes apparently wanting altogether. In either case, however, the same consequences result; the cornea becomes dif-

fusely clouded, the process generally, but not always, commencing at the limbus. This cloudiness may be quite without lines or dots of opacity, like ground glass. Again it may appear composed of innumerable minute opaque points or lines running in various directions. At first, the corneal epithelium escapes, presenting a regular and uniform polish, but afterward it becomes opaque. Again if the process involve the whole of the cornea, minute opaque spots may be seen in Descemet's membrane, giving it some of the characteristics of keratitis punctata. In the earlier stages there may be some pain and intolerance of light, but as a rule the disease, for a corneal affection, is comparatively painless. *The duration* of this disease is never short; it may continue for many months, and it shows a strong tendency to relapse. The most frequent *causes* are hereditary syphilis and struma. Mr. Hutchinson, of London, always examines the teeth of these patients to see if there be anything characteristic of hereditary syphilis. As the same or similar teeth are often noticed in strongly strumous subjects, it becomes doubly interesting to make the observation. One point is apparent in most of these cases, that there are in almost every patient some signs of badly developed physique—that is, faulty tissue elaboration. As a rule, both eyes sooner or later become affected, pointing to a constitutional origin of the affection.

In treatment we are often disappointed in our efforts. At the first, if there be pain or photophobia, atropine may be instilled, and the eyes bathed with warm or tepid water, several times a day. Tonics or alteratives are always indicated. One of the most useful prescriptions is the following:

℞.—Hydrarg. chlor. corros. . . . . gr. j.
Tinc. cinchon. comp.
Syr. aurantii . . . . . āā ℥iv.—Misce.

Dose.—One teaspoonful three times daily after eating.

Iodide of potassium is frequently given, and may very properly alternate with the mercurial; children will bear very large doses of the iodide, and indeed they are often necessary if we would get the curative effects of the drug; I would suggest from three to twenty grains three times daily, well diluted with water. Both these remedies may be continued for months, but ptyalism should always be avoided. Cod-liver oil with extract of malt may be administered. Whatever tends to improve the patient's general condition is indicated. Exercise in the fresh air is good, but the pernicious effects of cold must be avoided. Paracentesis of the cornea rarely does good, but occasionally iridectomy may be of benefit. The complication of iritis or irido-choroiditis is not common, though it does occur. When the disease becomes very chronic there will be hardly vascularity enough for the purposes of repair. This being the case, stimulating collyria may be used, similar to what is indicated in conjunctivitis. Olive oil and spirits of turpentine, in equal parts, may be applied to the eye every second day. Bathing with warm water, sufficiently to congest the eye, will sometimes be serviceable. An attack of acute conjunctivitis has been known to do good. But do what we may, this affection sometimes runs on unchecked for a very long

time. From some recent experiences I am inclined to believe that bichloride of mercury internally and atropine as a collyrium, are of as much value as any other agents in the treatment of this obstinate malady.

CHAPTER III.

TUBERCULOSIS.

THE term tuberculosis is applied to a disease which is characterized by the formation of small tubercles or nodules in one or more organs. Though more prevalent in some countries or localities than in others, it occurs in all or nearly all parts of the globe, from which we have exact information, and it has been more destructive to human life than any other one disease.

ETIOLOGY.—The most brilliant discovery of the last decade relating to the etiology of diseases, is that of the specific principle of tuberculosis. It has long been suspected by observing physicians that a specific cause did exist, and that this disease is to a certain extent infectious, but it is only recently that patient microscopic investigations have triumphed over the difficulties which surround this subject, and have detected the microörganism which has been so fatal to the human race. The honor of discovery belongs mainly to Dr. Koch, of Berlin. In his investigations Koch invariably found a certain bacillus in all recent tubercles, proving beyond a doubt that they always accompany the development of the tubercular nodule. By inoculating guinea-pigs, rabbits, and cats with tubercular material he communicated tuberculosis, reproducing the tubercular nodule, in which he always found the same bacillus. But it still remained to determine the relation of the bacillus to the tubercle, whether it was merely an accidental accompaniment, or whether it sustained a causative relation, producing the nodule by its irritating action on the cellular elements of the part where it happened to lodge. After many trials, Koch succeeded in preparing a pabulum in which the bacilli grew and reproduced their kind. By adding a little of the first cultivation to the pabulum, he produced a second cultivation, and after a series of cultivations he produced a bacillus which was evidently freed from all other substances. With the bacillus of the last cultivation he was able to produce the tubercular nodule, having all the characteristics which are observed when it is developed in the usual way in man. Different microörganisms take coloration differently, and Koch was enabled to discriminate the tubercular bacillus under all circumstances from other microbes by the peculiar color imparted to it.

The tubercle bacilli have the form of "delicate rods, from a quarter to half the diameter of a blood corpuscle in length." The more severe

the tuberculosis, the greater the number of bacilli. They occur not only in the recent tubercle, but also in immense numbers in the periphery of the caseous masses of a tubercular patient. They are found not only elsewhere, but also in the interior of the giant cells, as many as twenty even in some cells. They do not seem to have the power of movement, and oval spores are found in some of them. They grow in a temperature of 86° F. to 104° F., and not in a temperature outside these limits.

As might be expected, these microscopical researches of Koch have attracted wide attention, and have led to a repetition of his experiments by many pathologists, and to new experiments relating to the etiology of tuberculosis. The result has been to establish more firmly the views of Koch, and the doctrine that tuberculosis is a specific disease, and that the bacillus is the specific principle, appears to be fully established.

Among the most thorough and convincing researches bearing on the causative relation of microörganisms to tuberculosis, growing out of Koch's discovery, were those contained in a report to the London Association for the Advancement of Medicine by Research (*Practitioner*, London *Lancet*, March 17, 1883). Experiments were made with the cultivated bacilli obtained from Koch. "Twelve animals were inoculated with these organisms, chiefly into the anterior chamber of the eye, and all of them became tuberculous, and that more rapidly than after inoculation of tuberculous material. The tubercles produced in these cases were infective, and caused tuberculosis in other animals. On examination of tuberculous material, Koch's tubercle bacilli are always found, though in varying numbers. . . . About eighty organs of tuberculous animals and thirty-six cases of human tuberculosis were examined, and in all of these, without exception, tubercle bacilli were found."

The discovery of Koch has already proved of great importance as an aid in diagnosis, for the sputum of tubercular patients contains the bacillus. Tubercular sputum affords a soil in which the bacillus thrives and multiplies, as it does in the tissues of a tubercular patient, and by careful microscopic examination we are able to discover it in this sputum, while it is absent from non-tubercular sputum. According to Frisch (*Wiener med. Woch.*, No. 46, 1883), the bacilli were found without an exception in the sputum of 140 patients with confirmed tuberculosis, while the sputum of 150 non-tubercular patients was in every instance free from them. Heitler (*Wiener med. Woch.*, No. 43, 1883) examined the sputum of 140 tubercular patients, one of whom had miliary tubercles, and one other caseous pneumonia. All the other cases were chronic and were grouped by the author as follows: 1st. Six cases of old infiltration of the apices of the lungs, cured with the persistence of dulness on percussion, without râles. No bacilli observed. 2d. Twelve cases of tuberculosis with slight dulness and dry râles. In two of these, notwithstanding marked physical signs, fever was absent, and the tubercular process was arrested apparently; no bacilli. In the sputum of the remaining ten cases, bacilli were present in all the examinations except two. The third group contained cases of advanced and progressive tuberculosis, and the fourth group cases of

advanced chronic phthisis but with remissions. In the sputum of these two groups, bacilli were always observed. That Heitler, in six instances, witnessed the disappearance of bacilli when the tubercular process was arrested, is an interesting fact, as showing the relation of the bacilli to tuberculosis. He examined the sputum of twenty-nine non-tubercular patients, patients with pneumonia, bronchitis, bronchial dilatation, and putrid bronchitis with gangrene, and in no instance found the bacilli of tuberculosis.

As usually happens when a great discovery is announced, there are dissentients; there are those apparently competent to express an opinion, as Spina and Formad, who do not accept, or only partly accept the views of Koch. But the testimony of many observers, constantly accumulating, tends to establish more securely the doctrine of the parasitic origin of tuberculosis, and it is now apparently as securely established as most doctrines in pathology.

Koch's discovery necessitated revision of the teachings long accepted, relating to tuberculosis. The tubercular nodule is, as we will see, an aggregation of cells, produced from the cellular elements of the part where the nodule appears through a proliferating process, caused by an irritant, and in the light of our present knowledge we consider the bacillus to be the irritant. A local corpusculation, and a cellular nodule may be produced in the lungs or elsewhere by the lodgement of a non-specific irritant, whether organic or inorganic, as putrid cheese, particles of dust, or metallic particles, and thus far no cells have been discovered in nodules thus produced, which are characteristic of tuberculosis. The giant cells which at one time were thought to be peculiar to the tubercular nodule, have been found in growths of another nature, as in gummata. The characteristic and peculiar element in the tubercular nodule is the bacillus.

It has long been the belief from clinical observations, in Southern Europe, and of certain observing physicians in the temperate regions of Europe and America that phthisis is contagious, and the acceptance of the parasitic theory will probably soon render this belief an established principle in pathology. Already many instances have been published in the journals which appear to show the infectiousness of tuberculosis, as the following: In an inland town in Europe, a midwife with advanced phthisis, had been in the habit of blowing into the mouths of newborn infants, and so many of them perished of tubercular disease, as to excite attention and cause alarm, while those attended by a healthy midwife remained well. Dr. E. I. Kempf relates the following striking example in the Louisville *Medical News* for March 22, 1884: In the fall of 1880, a girl of eighteen years, whose brother had died of consumption, was found to have tubercles at the apices of both lungs. She slept in the general dormitory with the other sisters, and in four months nine of her companions began to cough, and were found to have tubercles. No one of the sisterhood had previously had disease of this kind. The fact that wives devoted in their attendance on consumptive husbands, frequently perished of the same disease, physicians in various countries have long remarked, but it has usually been attributed to the depressed state of system incident to long watching and grief, and not to any

contagious property. But now that a clearer insight has been obtained into the nature of tuberculosis, and both microscopical researches and clinical facts indicate its communicability, more caution will be exercised in the intercourse with patients.

The causative relation of scrofula to tuberculosis we have considered elsewhere, but we may here repeat that scrofulous ailments, especially the caseous products, afford the soil which is favorable to the growth and multiplication of the bacilli. Hence these microbes are not infrequently found in scrofulous products, showing that the tubercular has supervened on the scrofulous disease. Kanzler treats of the relation of scrofula to tuberculosis, in the *Berlin. klin. Woch.*, January 14, 1884. He believes that the two diseases are distinct, but that, as expressed by the French reviewer, *la scrofule offre un terrain de predilection pour le développement de la tuberculose.* He has discovered bacilli only in a minority of the local manifestations of scrofula, never in glands which had not undergone suppuration or caseation, never in eczema, impetigo, suppurative otitis media, and never in the nasal, conjunctival, pharyngeal, and vaginal catarrhs of the scrofulous. It is not till degenerative changes have occurred in the inflammatory products of scrofula, that the bacilli of tuberculosis appear, indicating the supervention of the latter disease.

Anatomical Characters of the Tubercle.—As Virchow pointed out, the tubercular nodule when recent, is semi-translucent and small, attaining about the size of a millet seed, and consisting mainly of cells. The cells which he considers characteristic of tubercle, and of which it is chiefly composed, resemble the white corpuscles of the blood in appearance and size, but some are smaller, and others larger than those corpuscles. They have been designated the lymphoid cells. Each cell when fully developed, has a bright homogeneous nucleus, small and spherical, or large and oval, and nucleoli. A large cell sometimes contains two or more nuclei. The lymphoid cells appear to be developed from the cellular element of the connective tissue. This is Virchow's belief. In addition to these cells, which constitute the greater part of the tubercle, large uninuclear cells are also observed, designated epithelioid cells. They resemble large and swollen endothelial or epithelial cells, and they are believed by pathologists to be produced from these cells, which lie within the area of the nodule. A third cell also occurs, known as the giant cell, from its size. It has many nuclei, and occupies chiefly the central part of the nodule. All these cells, as has been recently shown, occur in other pathological products, besides the tubercular nodule, and no one of them is therefore characteristic of it. But the element which is of greatest importance, since it sustains a causative relation to the disease, was, as we have seen, the last discovered. The bacillus is always found in the recent tubercle lying without the cells, as we have stated, but also in the interior of the giant cells, for which it appears to have an affinity. A fibrous network with more or fewer bloodvessels, surrounds the cells and holds them together. The bloodvessels belong to the normal tissues and are not a new growth, the tubercle having developed around them. The tubercles are single, or in clusters, forming masses of considerable size.

When the tubercle has attained a certain age, caseation always occurs

in its centre and extends outward, causing an opaque and yellowish-white dead mass, in which fragmentary cells can be observed under the microscope. Caseation is now known to be a form of decay which is common to pathological products of different kinds, and is not peculiar to tuberculosis, as was supposed before the time of Virchow. It occurs in consequence of abundant exudation or cell formation, and the compression and obliteration of vessels. It is, therefore, more common in scrofula than in any other disease, since scrofulous inflammations afford the conditions in which it is especially apt to occur. The yellow tubercle is, therefore, only an advanced stage of the semi-transparent or miliary tubercle. In the cheesy metamorphosis granules of fat are deposited within and around the cells, and the cells shrivel and disintegrate. These shrunken granular and fragmentary cells were believed to be the true tubercular cells until Virchow pointed out their true character. When the tubercle or the tubercular mass becomes yellow or caseous, and circulation ceases in it, it is surrounded by a vascular zone in which circulation still continues. It is very seldom, perhaps never, absorbed, although particles of it may enter the lymphatics or blood-vessels, and be carried elsewhere with the bacilli. It is an irritant, producing inflammation in the surrounding tissues, with thickening, induration, and abundant production of pus cells, which mingle with the elements of the tubercle. Its history henceforth is that of an abscess, and ulceration and discharge of the liquefied substance upon one of the free surfaces is the common result. In rare instances the tubercle, instead of cheesy degeneration, undergoes fibroid degeneration or cretefaction.

Various pathological conditions furnish the soil in which the bacillus obtains lodgement and grows, and in this way becomes a cause of tuberculosis. Cheesy pneumonia is not an infrequent cause of tuberculosis, and so are exhausting suppurations. During epidemics of measles many cases occur of cheesy pneumonia ending in tuberculosis. Cheesy and disintegrating lymphatic glands, as the bronchial, often also lead to tuberculosis.

Anatomical Characters in Infancy and Childhood.—The anatomical characters of tuberculosis in the first years of life vary in certain particulars from the form which they present in the adult, but after the age of three years the differences are fewer and less pronounced than previously.

Tubercular laryngitis, so common in the adult, is absent in a large proportion of cases under the age of three years, and when present it has little intensity. Ulceration of the larynx very seldom occurs. This has been attributed to the fact that there is so little expectoration in young children, the sputum being an irritant. Niemeyer, however, does not consider the sputum of tuberculosis sufficiently irritating to cause laryngitis and laryngeal ulceration; but the arguments in favor of this mode of causation, in my opinion, more than counterbalance those which have been presented against it.

I have never met a case of tubercular ulceration of the larynx or trachea in the post-mortem examination of young children, nor do I recollect ever treating a case in which there was that degree of dysphonia

which indicated ulceration. Rilliet and Barthez, in more than 300 necropsies of tubercular cases, found no ulcers in the larynx or trachea under the age of three years; but met 8 cases between the ages of three and ten years, and 8 between ten and fourteen years. The ulcers, whether seated in the larynx or in the trachea—and they are in most cases in the former, since the inequalities upon the surface of the larynx favor the retention of the sputum—are commonly small, superficial, round or elongated, and with little thickening or infiltration of their borders. Occurring in the folds of the mucous membrane, as, for example, around the vocal cords, their form is usually elongated.

Bronchitis is not infrequent. This inflammation is due to, and dependent on, the pulmonary tubercles, and is therefore most intense in the part of the lung where the tubercles are most abundant and furthest advanced. Consequently it is more intense on one side than on the other, and it may be unilateral. It differs in this respect from idiopathic bronchitis, which is commonly pretty uniform on the two sides. It differs also in the fact that it is sometimes accompanied by ulcerations. The ulcers are round or elongated in the direction of the axes of the tubes, and, like those of the larynx or trachea, are superficial. Idiopathic bronchitis of infancy and childhood does not cause ulceration. Circumscribed inflammation may attack a bronchial tube, as, indeed, the trachea, and give rise to ulceration and perforation, from the presence and pressure of a diseased lymphatic gland external to the tube. This subject will be treated of hereafter.

Lungs.—It is well known that in the adult, tubercles are always present in the lungs, if they occur in any part of the system. I have met two cases in which the lungs were free from tubercles in 36 post-mortem examinations of children who died of tuberculosis. One of the two was an infant, but its exact age is not stated in the records. It had cheesy degeneration of the thymus and bronchial glands, enlargement of the mesenteric glands, but without cheesy degeneration, and disseminated tubercles in liver and spleen. The other, fifteen months old at death, had tubercular meningitis, with numerous granulations upon the convexity of the brain, and the other usual lesions of meningeal inflammation, with bronchial and mesenteric glands slightly enlarged and cheesy, and one of the former softened. In one case, then, in 18, the lungs had escaped the disease. Rilliet and Barthez state that they found the lungs non-tubercular in 47 cases in 312, and Hiller did in 25 cases in 160. In their cases, therefore, the lungs were exempt from tubercles in about 1 case in 7. But it is to be recollected that the statistics of these observers were prepared at the time when all cheesy degenerations were thought to be tubercular, and the bronchial and mesenteric glands are sometimes cheesy when there are no tubercles or lesions referable to tuberculosis in any other part of the system. I have records of two such cases, which I reject from my statistics of tuberculosis, as there is no evidence that the disease was anything else than cheesy inflammation. Did I include these cases, my statistics would more closely correspond with theirs.

Pulmonary tubercles in children under the age of three years are, as a rule, discrete, and disseminated through the lungs. In cases at this

age, which have advanced to a fatal termination, we find yellow tubercles from the size of a pin's head to that of a shot in the different lobes; many still semi-transparent if the disease have been of short duration, but if protracted most of them yellow, and here and there one softened and surrounded by condensed fibrous tissue. Around the semi-transparent or gray tubercles, many of which were growing, and therefore were in the state of active cell proliferation at the time of death, narrow vascular zones can often be detected by the naked eye.

Under the age of three years, tuberculosis exhibits but little tendency, perhaps none, to affect the upper lobes sooner or in greater degree than the lower.

The following are the statistics relating to the site of the tubercles in the lungs in the cases which I have examined. All, it is to be remembered, were under the age of three years:

	Cases.
Tubercles disseminated throughout the lungs	26
Tubercles disseminated throughout the two upper lobes	3
Tubercles disseminated through right middle lobe and left lower lobe only	1
Tubercles disseminated through left upper lobe only	2
Tubercles disseminated (few and semi-transparent) in left lung only	1
Tubercles disseminated in three points in right, and two in left lung	1
No tubercles in lungs	2
	36

Between the ages of three and fifteen years, statistics show that the upper lobes are more liable to tubercles than the lower; but the difference in liability is not great. In many cases occurring in this period, the different lobes are affected nearly simultaneously, and not very infrequently the upper lobe is the last which is involved. In October, 1866, I made the post-mortem examination of a boy who died in the Children's Service of Charity Hospital, at the age of fifteen years, and small scattered tubercles were found in the lower lobe of the left lung, while all other portions of these organs were healthy. Rilliet and Barthez, who include in the same statistics all cases from birth to the age of fifteen years, found gray semi-transparent tubercles

	Cases.
In the right superior lobe in	63
In the right middle lobe in	43
In the right lower lobe in	55
In the left superior lobe in	65
In the left inferior lobe in	54

The same observers found yellow tubercles in the

Right superior lobe in	40
Right middle lobe in	28
Right inferior lobe in	39
Left superior lobe in	35
Left inferior lobe in	31

Tubercle, especially when softening commences, is itself an irritant, exciting inflammation around it. Inflammation occurring from this cause

is obviously likely to be protracted, continuing for weeks or months, unless the tubercular matter be eliminated by ulceration. The highly vascular and delicate lungs of the young child are very liable to inflammation when they are the seat of tubercles, and as the tubercles are disseminated, the pneumonia is commonly more extensive than when it occurs from ordinary causes. In fifteen, or nearly one-half of my cases, there was pneumonia affecting portions of one or more lobes, or an entire lobe. From the extent and position of the solidified portions, it was obvious that in most instances the inflammation originated from the irritating effect of the tubercular matter, while in others it was due to hypostatic congestion, occurring in consequence of the long-continued recumbent position and feebleness of circulation. In these fifteen cases the seat and extent of the inflammation were as follows:

	Cases.
Nearly entire right lung	2
Nearly entire middle and lower lobe	1
Entire left upper lobe	2
A considerable part of both lungs	1
Posterior parts of both lower lobes	4
Posterior part of left lung	1
Left lower lobe, and right middle and lower lobes	1
Left upper lobe (contained a large cavity) and posterior part of left lower lobe	1
Nodules of inflamed lung around tubercles	2

The inflammation in about one-third of the cases was due to hypostasis, since it occurred in depending portions, extended but little into the lungs, and sustained no relation to the amount of tubercle. It was in the stage of red or, more rarely, of gray hepatization.

In seven of the cases there were pulmonary cavities as large in proportion as we ordinarily find in tuberculosis of the adult. The seat of one was in the right lower lobe; of two, the left upper lobe; of one, the right upper lobe; of another, the right lung, its exact seat not stated; and in the remaining case the cavity, which was the largest of all, occupied the interior of all three lobes on the right side. Some idea of the size of these cavities may be learned by the following extracts from the records: 1st Case. "A small superficial cavity communicating on one side with a bronchial tube, and on the other side with a small circumscribed collection of pus in the pleural cavity." 2d Case. "Cavity of the size of a hickory-nut." 3d Case. "Cavity of the size of a large hickory-nut." 4th Case. "Cavity three-fourths of an inch in diameter." 5th Case. "A large abscess." 6th Case. "The cavity occupied nearly the whole of the interior of the left upper lobe." 7th Case. "About half the right lung excavated into a cavity which extended through the three lobes."

Circumscribed pleuritis, produced by tubercles underneath the pleura, was observed in seven cases. It was ordinarily attended by little exudation except the fibrin, but in one case a sufficient amount of serum had been exuded to compress considerably the lung. Pus was not observed in any notable quantity.

Emphysema was present in several cases, chiefly in the upper lobes, sometimes vesicular, with fulness or bulging of the lung, an anæmic

appearance of it, and doughy, inelastic feel. In other cases emphysema was interstitial, producing little bladders of air under the pleura, especially toward the root of the lung, or separating the lobules by wedge-shaped or irregular interspaces filled with air. In one case air had escaped from an emphysematous bladder into the right pleural cavity, causing pneumothorax and collapse of the lung.

Next to the lungs, the bronchial glands are more frequently diseased than any other organs, in the tuberculosis of infancy and childhood.[1] They undergo the successive structural changes which characterize glandular inflammations, namely, hyperplasia, and more or fewer of them cheesy degeneration and softening. In the state of hyperplasia their firmness is diminished, and they have a pale flesh-color. Cheesy degeneration commences in one or more points in the gland, sometimes in the peripheral, sometimes in the central portion, and it extends till the whole gland presents the well-known cheesy appearance. When the gland softens, the thick liquid has a puriform appearance, consisting of amorphous matter, fatty particles, and the shrivelled and disintegrated cells of the gland. Soon pus-cells occur, and their number increases.

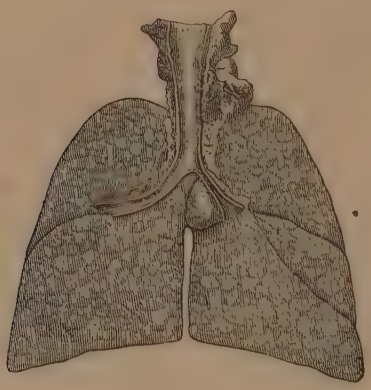
Rilliet and Barthez state that the bronchial glands were tubercular in 249 cases in children, while the lungs were tubercular in 265. All cheesy glands, it is to be recollected, they considered tubercular. In 4 of the 36 cases which I have examined, no record was preserved of the state of the bronchial glands; in one case there was no perceptible hyperplasia and no cheesy degeneration; in two there was hyperplasia, but no cheesy degeneration, while in the remaining twenty-nine cases there was cheesy degeneration of more or fewer of the enlarged glands, or parts of them, with occasional softening. In the fact that the bronchial glands are enlarged and caseous, we have an explanation in part of the fact, that the symptoms in the tuberculosis of young children differ from those in the adult, since Louis found the bronchial glands involved in only twenty-eight per cent. of the adult cases of tuberculosis which he examined, and Lombard in only nine per cent. A gland pressing upon the recurrent laryngeal or pneumogastric nerve, or the trachea, may give rise to dyspnœa and a cough; or on the descending vena cava or one of the venæ innominatæ, to congestion of the brain and meninges, intracranial serous effusion, and even thrombosis in the cranial sinuses. That a softened bronchial gland is not infrequently eliminated from the system, by ulceration, into a bronchial tube or into the trachea, is well known. In one case which I observed the ulceration had destroyed portions of three of the cartilaginous rings of a

[1] The term bronchial phthisis has long been applied to that state in which the bronchial glands are enlarged and cheesy. Now this glandular disease, we have seen, is often the result of inflammation in the strumous; and while it may be the cause of tubercular infection, is probably not, in most instances, tubercular itself. But microscopy has not yet drawn the distinction between the cells of lymphatic glands, which cause the enlargement by proliferation when the glands are inflamed, and the cells of the tubercular neoplasm. They appear alike in the field of the microscope. Therefore it seems proper not to attempt to distinguish scrofulous glands from tubercular, when they occur in a patient affected by tuberculosis.

bronchus, and the aperture was plugged by a cheesy fragment of a softened gland which protruded. Occasionally, it is stated by authors, the ulceration is into one of the large vessels of the mediastinum, or even into the œsophagus.

The following is an example of bronchial phthisis, as it commonly occurs. This case, which is not included in the foregoing statistics, was seen almost daily by me during its entire progress. On September 3, 1874, I examined an infant in the New York Infant Asylum, who had wheezing respiration during the last eight days. The wheezing occurred both on inspiration and expiration, and also, though less pronounced, during sleep; pulse 96, respiration 40, temperature normal. Its mother, who had charge of it, and had till recently wet-nursed it, had unequivocal symptoms of tuberculosis for several months. The child was pallid, and its flesh was soft and flabby. The fauces were perhaps a little redder than usual, but were otherwise normal, and a careful exploration of the chest revealed no cause of the embarrassed respiration. Auscultation and percussion gave a negative result. In the latter part of September a troublesome diarrhœa occurred, which continued more or less till near death. The temperature on September 28th, October 8th, 10th, and 11th, was 100½°, 100°, 99½, and 100°. The pulse on October 10th and 11th was 120 and 126. On October 8th the per-

Fig. 20.



cussion-sound over the upper part of the right lung seemed somewhat duller than on the other side, though the respiration was not observed to be notably changed in the area of the dulness. There was but little cough during the entire sickness. Death occurred on October 20th. At the autopsy the bronchial glands were found enlarged and cheesy, and underneath the right bronchus, near the bifurcation, was a softened, almost diffluent gland, as large as a small hickory-nut, and compressing the bronchus. This, no doubt, had produced the wheezing respiration, which had been the chief local symptom. The lungs, spleen, and in less degree the liver, contained numerous small miliary tubercles. Certain of the mesenteric glands were also cheesy, but to a less extent than the bronchial. The disease of the bronchial glands was evidently primary,

the tubercles of the lungs and abdominal organs being apparently quite recent. The accompanying woodcut, from a photograph by Mr. Mason, the photographer at Bellevue Hospital, represents a posterior view of the lungs and air-passages.

In no case have I found tubercles in the heart or pericardium, though they have been observed in rare instances in the latter. The mesenteric glands were enlarged by hyperplasia, and more or less cheesy, in 30 cases, were apparently normal in 2 cases, while in the remaining 4 cases their condition was not stated. In most of the patients the mesenteric glands were smaller and less cheesy than the bronchial, but in a few instances they were larger than the bronchial and more cheesy.

It is a noteworthy fact, as bearing on the causative relation of these glands to tubercles, that not infrequently the amount of hyperplasia and cheesy degeneration occurring in the former was very considerable, while the tubercles in the lungs or elsewhere were small, even minute, semi-transparent, and evidently of recent formation. It appeared as if in such cases the glandular hyperplasia and degeneration, bronchial or mesenteric, or both, preceded the general tubercular disease, and probably sustained an etiological relation to it. Since the cases which furnished the above statistics occurred, my clinical experience with tuberculosis has greatly increased, but nothing new or different has been observed at autopsies.

Abdominal Viscera.—In children, tubercles in the solid organs of the abdomen rarely give rise to appreciable symptoms, since they are small and disseminated, not impairing materially the function of the part in which they are located. On the other hand, peritoneal and intestinal tubercles, and the enlarged and cheesy mesenteric glands, give rise to symptoms which require description. The most frequent seat of peritoneal tubercles is upon the attached surface of the peritoneum, where they are formed in the connective tissue. They are distinctly seen through the peritoneum, and cause some prominence of it. Exceptionally their seat is upon its free surface. Every portion of the peritoneum, whether visceral, parietal, or omental, is liable to tubercles, but generally tuberculization of so extensive a surface does not occur in any one case. The tubercles are spherical or lenticular, and most of them small. Sometimes they are very numerous, but so minute as to be scarcely visible. They are gray or yellow, according to the age. Peritoneal tubercles often produce circumscribed peritonitis, causing adhesion of opposite surfaces. The tubercles in themselves cannot be detected by palpation; but masses or *placques* composed of tubercles and inflammatory products are sometimes so large that they can be felt through the abdominal walls.

The symptoms of peritoneal tuberculosis are attributable, for the most part, to the peritonitis. Among them may be enumerated abdominal tenderness or pain, meteorism, ascites—usually slight—and derangement of the bowels, commonly diarrhœa. As tubercles in this situation occur, in most cases, subsequently to tubercles elsewhere, the symptoms which have been described are associated with and are subordinate to others.

Stomach and Intestines.—The most common seat of gastro-intestinal

tubercles is the small intestine, and more frequently its lower portion, near the ileo-cæcal valve, than its upper or central. They are rare in the duodenum or contiguous part of the jejunum. They are developed ordinarily in the connective tissue, either that lying under the mucous or the serous surface.

Gastro-intestinal tubercles are often accompanied by ulceration of the adjacent mucous membrane. But in a certain proportion of cases there is probably no causative relation of the tubercles to the ulcers, for ulceration of this membrane is not infrequent in the tuberculosis of children, when there are no tubercles in the walls of the stomach or intestines. The following statistics of Rilliet and Barthez, relating to this point, will aid to an understanding of the symptoms.

Tubercles in walls of stomach, 7 cases, { with ulcers, 6 cases. / without ulcers, 1 case.
Ulcers of gastric mucous membrane, without gastric tubercles, 14 cases.
Tubercles in small intestines, 82 cases, { with ulcers, 70 cases. / without ulcers, 12 cases.
Ulcers without tubercles in small intestines, 51 cases.
Tubercles in large intestine, 15 cases, { with ulcers, 10 cases. / without ulcers, 5 cases.
Ulcers in large intestine, without tubercles, 47 cases.

The ulcers have vascular, thickened, and infiltrated borders. Their diameters vary from a line to half an inch or more, and their general form is circular, or, if two or more unite, irregular. Tubercular ulcers of the stomach are mostly in the great curvature, those in the small intestines in the ileum and lower part of the jejunum, and those of the large intestine in the cæcum.

The following table exhibits the state of the principal abdominal viscera in the 36 cases embraced in my statistics:

	Liver.	Spleen.	Kidneys.
Tubercular	12	22	1
Non-tubercular	16	6	21
Not stated	8	8	14
Fatty	5	0	0

In no instance did I observe tubercular softening in the abdominal organs, and a large proportion of the tubercles in the liver, spleen, and kidneys were still in the first stage. In the five cases in which the liver was recorded fatty, this state of the organ was obvious to the sight, as it is in tuberculosis of the adult. A moderate excess of fat in the hepatic cells may have been present in some of the other cases, but it was not sufficient to be appreciable without the microscope. It is to be remarked that in the five cases in which the liver was recorded fatty, this organ contained no tubercles. The spleen is seen to have been the most frequent seat of tubercles of all the viscera, except the lungs. In fourteen cases the intestines were examined; and in five, tubercles discovered developed in their connective tissue. The intestinal tubercles were small, and ulceration had occurred of the mucous membrane which covered them.

The brain was examined in fifteen cases. In twelve the amount of

cerebro-spinal fluid varied from ʒss to ʒv by estimation. In two others the records state that there was a considerable amount of this fluid, the exact quantity not being given, while in the remaining case congestion of the brain and meninges was noticed, but nothing was recorded in regard to the amount of cerebro-spinal fluid. The increase of the cerebro-spinal fluid in tuberculosis is attributable to wasting of the brain, a *hydrocephalus ex vacuo*, and in some cases to passive congestion and serous transudation, due to feeble circulation, or obstructed flow from the pressure of bronchial glands on the vessels within the thorax, as already stated.

Tubercles were present in the pia mater in three cases: in two with fibrinous exudation; in the other without fibrin or other evidence of inflammation. Tubercular meningitis is described in another part of this book.

Symptoms.—The symptoms in tuberculosis of children arise in part from the diathesis, and in part from the tubercles. Before the period of tubercles, there are signs of failing health, such as loss of appetite, flabbiness of the soft parts, or emaciation, lassitude, and loss of strength. These symptoms continue after the formation of tubercles, and increase.

The features are ordinarily pallid, but during the paroxysms of fever, to which tubercular patients are subject, they may be flushed. Lividity of the features, due to imperfect decarbonization of the blood, occurs, if there be enlarged bronchial glands which compress the vessels within the thorax, or if there be extensive pulmonary tuberculization, or pulmonary tuberculization, whether extensive or not, which is complicated by capillary bronchitis or pneumonia.

The skin is nearly natural, or it loses its flexibility and softness, and becomes dry and rough. In some patients there is, at times, general or partial furfuraceous desquamation of the skin, due to exaggerated development of the epidermis. Children, like adults, notwithstanding the general dryness of the surface, are liable to perspirations at night and in sleep. This symptom is less frequent at the commencement than at an advanced period, and in acute than in chronic cases, in young, namely, those under three or four months, than in older children. It is more abundant about the head and limbs than elsewhere, and is sometimes confined to these parts.

Anasarca is not infrequent. It sometimes arises from obstructed circulation, in consequence of compression of the thoracic vessels by enlarged lymphatic glands; in other cases it is due to diminished plasticity of the blood, a result of the tubercular cachexia. The latter is the more common cause. It is not an important symptom, on account of the small amount of serous transudation, and the character of the parts in which it occurs.

Emaciation, already alluded to, is early, constant, and progressive. Under the age of six or eight months it is less marked than in older children, many preserving considerable rotundity of features and form even in advanced tuberculosis. The failure of the strength corresponds in amount and progress with the emaciation. Slight at first, and exhibited only by a degree of lassitude, it gradually increases, till for

weeks before death the little patient is fatigued by the ordinary muscular movements, and is disposed to keep quiet.

The nervous system is not ordinarily affected except in cases of intracranial tubercles. In acute tuberculosis, or tuberculosis complicated by severe inflammation, there may be agitation and delirium, especially at night.

In most patients the mucous membrane of the buccal cavity presents its normal appearance, with the exception of a moist fur upon the tongue, and a paler hue than normal of its surface generally. In acute tuberculosis, and in cases complicated by inflammation, the tongue is sometimes dry and brown. The appetite may be normal till the close of life, or it is poor or changeable. Occasionally it is increased, although the disease is progressing. The bowels are regular or relaxed. Diarrhœa may be a prominent symptom, even when there are no intestinal tubercles or ulceration. Meteorism and fulness of the abdomen are common.

Fever, constant, but usually with evening exacerbation, is rarely absent. It continues for weeks or months. During the exacerbation the pulse rises to 120, 140, or even to 180 beats per minute, and there is a corresponding exaltation of the temperature, which in the latter part of the day, without inflammatory complication, ranges from 100° to 102° or 103°. The febrile movement is a symptom of diagnostic value as regards the nature of the disease, though it does not indicate the seat of the tubercles.

In addition to the symptoms now described, there are *special* symptoms, due to tuberculization of the different organs. In young children, on account of the fact already referred to, to wit, the tendency to a generalization of tubercles, there is apt to be a blending of the symptoms which arise from different organs, but with care it is not difficult in most instances to isolate and refer them to their proper source. The following are the symptoms which arise from tuberculization of the more important organs.

Encephalon.—The symptoms produced by tubercles of the encephalon vary according to their seat and size, and the structural changes in surrounding parts to which they give rise. Meningeal tubercles, which are located for the most part in the meshes of the pia mater, and ordinarily along the course of the small arteries, are, as a rule, small, not more than a line in diameter, and they may remain latent for a considerable time. In the majority of cases, however, they sooner or later cause meningitis, the symptoms of which are well known and need not be described. But tubercles in this situation do sometimes give rise to symptoms when there is no meningeal inflammation. They occasion congestion of the surrounding vessels, and serous transudation, and, if developed on the under surface of the pia mater, they may produce symptoms by encroaching upon and irritating the brain; for they are sometimes so much embedded in the convolutions that careful examination is required in order to determine that they are meningeal, and not cerebral. Among these symptoms may be mentioned headache, frontal or occipital, sometimes intermittent, nausea, melancholy, and in certain cases the symptoms produced by serous transudation.

The symptoms of *cerebral* are in part similar to those of meningeal tubercles, but in most cases others of a neuropathic character are present, which serve for differential diagnosis. The differences as regards the symptoms of different patients affected with cerebral tubercles are attributable in part to the fact that their size and rapidity of growth vary, but more to the difference in their seat; for any part of the brain may be the seat of tubercles, though certain portions, as the cerebellum, are more frequently affected than others.

The child with cerebral tubercles is quiet, but irritable and easily excited. Delirium is not common, but many before the close of life exhibit a degree of mental dulness. The headache, common in cases of cerebral as well as meningeal tubercles, may be nearly general, or it is frontal, parietal, or occipital, according to the seat of the tubercles. It is often lancinating, often intermittent.

Clonic convulsions occur toward the close of life. Exceptionally they are among the earliest symptoms. Observations have failed to establish any relation between the seat of the tubercles and the localization of the convulsions. The convulsions may be unilateral, while the tubercles are in both hemispheres; or general, while the tubercles are on one side only.

The severity and duration of the convulsive attacks, and the frequency of their occurrence in tuberculosis of the brain, vary greatly in different patients. They have been attributed to softening of the cerebral substance, which sometimes occurs immediately around the tubercles, to local congestions excited by them, and also to serous effusions in the ventricles. The convulsions, sooner or later, end in paralysis or coma.

Contraction, or tonic convulsion of certain muscles, is sometimes observed. Its most frequent seat is in the muscles of the back, and of one or both of the lower extremities. It is a late symptom. It occurs in those cases in which there is softening around the tubercles, and usually in the muscles of the opposite side.

Paralysis is also a late, but not an infrequent symptom. It is preceded by headache, and sometimes, as already stated, by convulsions. Occurring as a symptom of tuberculosis of the brain, it is due either to pressure on a cranial nerve, or to compression and perhaps softening of the cerebral substance. The paralysis may be paraplegic, commencing as feebleness of the lower extremities, and increasing until it becomes complete, or a more or less complete, hemiplegia. In paraplegia due to tubercles of the brain, the cerebellum is, as a rule, their seat; while paralysis of one side, or of certain muscles of one side, indicates tubercles of the opposite cerebral hemisphere; but there are exceptions. Paralysis of the third cranial nerve gives rise to ptosis, of the sixth to paralysis of the external motor nerves of the eye, and therefore to internal strabismus.

Feebleness or loss of vision, inequality, oscillation, and finally dilatation of the pupils, are not infrequent symptoms of tuberculosis of the brain, and they possess great diagnostic value. Atrophy of the optic nerve, causing amaurosis, sometimes results from tubercles as well as other tumors of the brain. Atrophy of this nerve occurs not only when the tubercles are so located as to press on the optic tract, in

which case the explanation is apparent, but also, in certain patients, when the tubercles are in other parts of the brain. In these last cases it is thought by Brown-Sèquard and others that the imperfect nutrition of the nerve is due to contraction of its nutrient vessels, produced by the tubercles through reflex action.

In tuberculosis of the brain, symptoms pertaining to the respiratory, circulatory, and digestive systems are either absent or are quite subordinate to those of a neuropathic character. Slowness of the pulse, with or without intermittence, has sometimes been observed, and it is therefore a symptom of some diagnostic value. Toward the close of life both pulse and respiration are apt to be accelerated. Vomiting, constipation, and retraction of the abdomen, which are so common in meningitis, are only occasional symptoms.

Bronchial Glands.—During the progress of tuberculosis, hyperplasia, cheesy degeneration, and softening of various lymphatic glands may occur throughout the body, but the bronchial and mesenteric are not only those which are most frequently affected, but they are the only glands, unless in exceptional instances, which materially increase the danger or give rise to special symptoms. These symptoms either have a mechanical cause, namely, the pressure exerted by the enlarged glands on contiguous parts, or they are due to softening of the glands and consecutive inflammation and ulceration.

The following are the principal symptoms due to compression. Some of them are not infrequent, others are rare. Compression of the pulmonary veins retards the flow of blood from the lungs to the left auricle, giving rise to congestion, and, in extreme cases, œdema of the lungs, with sanguineous extravasation into the lung-substance, congestion of the right cavities of the heart, hepatic veins, and of the systemic capillaries generally. Compression of the pneumogastric nerve, or of the recurrent laryngeal, which is the motor nerve of the laryngeal muscles, modifies the voice, and produces a cough which is apt to be spasmodic. The cough resembles that of pertussis, and has been mistaken for it, but it is not so violent or protracted. The voice, clear and natural at first, becomes by degrees hoarse or feeble from deficient innervation of the laryngeal muscles.

An enlarged gland, or mass of glands, lying against the trachea or one of the bronchial tubes (this may occur with tubes up to the third or fourth division), and pressing its walls inward, obviously obstructs more or less the current of air. If there be considerable obstruction, a loud, sonorous râle is produced, which is heard distinctly at a distance from the chest, obscuring other râles. It is loudest when the patient is agitated, and it sometimes intermits. Feeble respiratory murmur, dyspnœa, and a cough are not infrequent in bronchial phthisis. Diminished intensity of the respiratory murmur is general or partial, according to the seat of the compression. It has been most frequently observed at the summit of the lungs. In certain patients this symptom is not constant, the respiration being for a time feeble and then normal. The dyspnœa may be a prominent and distressing symptom, the alæ nasi dilating, and the inframammary region sinking with each inspiration. The cough which occurs when a gland presses on the

trachea or bronchial tube, is due to the tracheitis or bronchitis to which the pressure gives rise. If ulceration occur at the point of pressure, the cough continues as long as the ulcer remains. Compression of the large veins within the thorax, which return blood from the head and upper extremities, causes more or less congestion of these parts, with, perhaps, transudation of serum in the subcutaneous connective tissue, and within the cranium. Rarely, a softened gland by ulceration gives rise to other symptoms than those mentioned, namely, hemorrhage by ulceration into a vessel, or pleuritis or pneumonitis if the ulceration be toward the lungs.

Improvement in the condition of the patient affected with bronchial phthisis is not unusual. It may be permanent, but in most patients it is temporary, so that in a few weeks or months the symptoms are as severe as before. The improvement is due to softening and elimination of a gland which had given rise to symptoms by its mechanical effect, or by the inflammation which it had excited.

Physical Signs.—These are absent or obscure in the incipient disease, when the glands are small, and they are most marked in those cases in which the glands are so large as to press on the thoracic walls, since they then become the medium for the transmission of sounds to the ear. The part of the thorax against which they most frequently press is the dorsal vertebræ, from the first to the sixth, and each side of the vertebræ, and less frequently the upper third of the sternum. The physical signs are dulness on percussion over the interscapular space, and perhaps, though to a less extent, over the upper part of the sternum, and bronchial respiration in the same situations. Occasionally a bruit can be detected, due to the pressure of a gland on one of the large vessels of the chest.

Lungs.—A cough is one of the earliest and most persistent of the symptoms of pulmonary tuberculosis. It is so rarely absent, that those of large experience do not meet with more than one or two such cases. It varies in severity and frequency. If the tuberculosis be acute and its course rapid, the cough, even from its commencement, is frequent, so as to weary the patient and deprive him of needed rest. But in ordinary cases, that is, when the disease is chronic, it commences gradually, attracting little attention by its infrequency, but becoming more frequent and painful as the malady advances.

Ordinarily the cough is dry in the first weeks or months, but it becomes looser in the course of the disease, from the greater amount of bronchial inflammation. In exceptional instances it has a spasmodic character, like that produced by pressure of an enlarged bronchial gland on the pneumogastric or recurrent laryngeal nerve. This occurs from the accumulation of viscid mucus in one or more of the bronchial tubes, usually in dilated portions of them, from which it is with difficulty expectorated.

The respiration in pulmonary tuberculosis is accelerated in proportion to the degree of tuberculization. Tuberculization of a considerable part of both lungs gives rise to dyspnœa, especially when, as is ordinarily the case, bronchial, pulmonary, or pleuritic inflammation has supervened. Pneumonitis or pleuritis gives rise to the expiratory moan, and as these

inflammations, when induced by tubercles, are protracted, this symptom may continue for weeks or months.

Patients under the age of six years do not expectorate, or but rarely. After this age expectoration is not common in the commencement of pulmonary tuberculosis, but in the confirmed disease it is a pretty constant attendant of the cough. Hæmoptysis is also rare under the age of six years, and less frequent subsequently than in the adult. It is most apt to occur in those cases in which there is already passive congestion of the lungs, produced by the pressure of enlarged bronchial glands in the manner already described. Patients old enough to make known their subjective symptoms, sometimes complain of fugitive pains under the sternum or between the shoulders.

In young children the physical signs of incipient pulmonary tuberculosis are wanting, or are so obscure as not to be readily recognized. This is due to the small size and dissemination of the tubercles. In older children the physical signs appear early, and are readily recognized, because, as a rule, the tubercles are aggregated, and are more frequently at the apices of the lungs as in the adult, than elsewhere. In the advanced disease, whether in infancy or childhood, when inflammation and more or less destruction of the lung substance have occurred, the physical signs, so far from being obscure, enable us in most cases, in connection with the history, to make an immediate and positive diagnosis.

In young children affected with pulmonary tuberculosis the irregular and imperfect expansion of the lungs produces by degrees changes in the shape of the thorax, which are apparent on inspection. In some, the lungs being habitually imperfectly inflated, the obliquity of the ribs is increased, and the thorax consequently elongated, while its antero-posterior and transverse diameters are diminished. This obviously increases the convexity or arch of the diaphragm, so that this muscle sometimes lies against the thoracic walls as high as the ninth or even eighth rib. If the costal cartilages are yielding, there are anterior flattening of the chest and depression of the sternum; if they are firm, on account of the more advanced age, the chest remains circular.

Another shape of the thorax is not infrequent in feeble tubercular children, especially infants, who have suffered from repeated attacks of bronchitis. It occurs also in the non-tubercular, if the conditions which favor it are present. The conditions are, on the one hand, feebleness of the patient, with diminished force of respiration and impaired resiliency of the ribs; and, on the other, obstruction by mucus of one or more of the bronchial tubes. Occlusion, more or less complete, of a bronchial tube, and consequent obstruction to the current of air, produces a corresponding degree of collapse in the portion of lung to which the tube leads. The parts which collapse are, in most cases, the lower lobes, and the thin anterior margins of the upper lobes. This causes lateral depression of the lower ribs, except such as are pressed outward by the abdominal viscera, and an anterior projection of the lower part of the sternum. The shape of the thorax in these cases differs from that in rachitis, in the fact that the lateral depression does not extend to the upper ribs, nor does the upper part of the sternum project.

Certain precautions should be observed in examining the chest by percussion and auscultation. The child should sit or recline, with the arms and shoulders in the same position, and the axis of the trunk straight. Inclination of the trunk to either side, raising or depressing a shoulder, may produce an appreciable difference in the two sides as regards the physical signs. Percussion of the two sides should be practised at the same stage of respiration. A slight difference in the degree of resonance does not afford proof of disease, unless it be observed at different examinations; for, in feeble children, it often happens that all portions of the lungs do not expand alike, so that where we have noticed slight dulness at one visit, it may by the next have disappeared, or even at the same visit, if forcible inspirations be excited.

The physical signs ascertained by palpation, auscultation, and percussion are, as in the adult, vocal fremitus, bronchial respiration, bronchophony, and dulness on percussion. In these cases in which the tubercles are mainly at the apices of the lungs, diminished expansion of the infraclavicular region is observed during inspiration, and this part of the thoracic wall is permanently depressed, so that the clavicles are unusually prominent. If there be emphysema, this flattening does not occur, or is slight. Dulness on percussion, though more frequently observed in the infraclavicular region than elsewhere, may be present in different isolated places. If pneumonia supervene, the dulness not infrequently extends over a considerable part of one lung. The cracked-pot sound is often observed on percussion, but it possesses no diagnostic value. It can be produced, when there is no pulmonary disease, by percussion over a bronchus.

Bronchial respiration and bronchophony are important signs, as indicating solidification of the lung, but they do not show whether the solidification be tuberbular or pneumonic, or the two conjoined. This must be determined by the history of the case, the extent of surface over which these signs are heard, and their persistence. When the tubercles begin to soften, and the lung-tissue breaks up, moist râles appear, often hoarse and gurgling, obscuring the bronchial respiration. A cavity in the lung, or pneumothorax, is attended by the same physical signs as in the adult.

Pleura.—Little need be said in reference to the symptoms and physical signs of tuberculosis of the pleura, since this affection is in most instances associated with tuberculosis of the lungs, and is not distinguishable from it. But now and then the pleural tubercles are numerous and large, giving rise to symptoms, while those of the lungs are small, few, and without symptoms, or attended by symptoms which are quite subordinate. Either the costal or visceral portion of the pleural may be the seat of tubercles. They are developed directly under the pleura, or upon its free surface. They are very apt to occur in the newly formed connective tissue which results from pleuritis. Those located upon the free surface, or under the costal pleura, rarely soften, while those under the visceral pleura sometimes soften and cause ulceration. Occasionally numerous aggregated tubercles form a firm continuous layer upon the surface of the pleura, preventing, if upon the visceral pleura, full expansion of the lung. This may give rise to a

degree of dulness on percussion, and feebleness of the respiratory murmur. Ordinarily, however, in this form of tuberculosis, the symptoms and physical signs, so far as any are observed, are due to the pleuritic inflammation which the tubercles excite.

Stomach and Intestines.—The symptoms in tuberculosis of the stomach and intestines vary according to the seat and stage of the tubercles.

Tubercles, whether gastric or intestinal, are not at first accompanied by symptoms, or the symptoms are obscure and ill-defined. Symptoms arise when inflammation occurs in the adjacent tissues. Diarrhœa is one of the most common and persistent of the symptoms. The alvine discharges are brown and thin, and sometimes, in advanced cases, very offensive. They may be streaked with blood which has escaped from the ulcers. Intestinal tubercles, developed immediately underneath the peritoneal coat, sometimes cause local peritonitis, usually of little extent. This gives rise to circumscribed pain, tenderness, and more or less meteorism.

Diagnosis.—It is evident from the foregoing description of symptoms that the diagnosis of incipient tuberculosis is much more difficult in children than adults. Before commencing the examination, it is best to learn the hereditary tendencies of the family and the history of the patient, especially as regards antecedent diseases or debilitating agencies, and the duration of the symptoms.

Early and accurate diagnosis of tuberculosis in the child, as well as in the adult, is now rendered possible by the discovery of the tubercle bacillus, in 1882, by Koch. This bacillus abounding in the sputum, as well as in the affected organs of phthisical patients, having a slender rod-like form, having a length varying from one-fourth to the entire diameter of the red blood-corpuscles, and susceptible of a peculiar staining by the aniline colors, which differentiates it from all other bacilli, is, as we have stated above, believed to be uniformly present in tuberculosis, and absent in other conditions.

Children with tuberculosis of the lungs expectorate comparatively little, but sufficient sputum can probably be obtained in most instances for the purpose of diagnosis. The presence of the bacillus indicates clearly the tubercular nature of the disease.

Tuberculosis of the encephalon is diagnosticated with more difficulty than that of the thoracic or abdominal organs; but certain of these organs are in most patients tubercular at the same time, and the knowledge of the fact that they are affected aids in the diagnosis of the disease of the brain or its meninges. Among the symptoms of intracranial tuberculosis which possess diagnostic value may be mentioned cephalalgia and more or less fever, with exacerbations in the commencement of the disease, and, at a more advanced period, strabismus, inequality or irregular action of the pupils, impairment of vision, retraction of the head, and convulsive movements or paralysis.

In certain cases careful observation and discrimination of symptoms are requisite, in order to determine whether they arise from intracranial tubercles, or from congestion of the brain caused by obstruction in the venous circulation by the pressure of enlarged bronchial glands.

The diagnosis of bronchial phthisis, when the glands are still small, is necessarily uncertain, on account of the absence of symptoms. When they have increased in size and are so located as to press on the pneumogastric or recurrent laryngeal nerve, producing the spasmodic cough already described, the differential diagnosis between that disease and pertussis may be made by attention to the following facts: Bronchial phthisis occurs singly, and is non-contagious, while pertussis occurs as an epidemic, and with evidences of contagion. There are no successive stages, to wit, those of catarrh, paroxysmal cough, and decline, as in that disease, and the cough, though paroxysmal, is short, and without whoop or vomiting.

In feeble children, with inherited tubercular diathesis, emaciation, sweats, and a chronic cough, with the absence of pulmonary symptoms, should excite suspicions that the bronchial glands are involved. The evidence is almost conclusive if the cough become paroxysmal, and there be a loud, persistent tracheal or bronchial râle.

FIG. 21.

Bacillus tuberculosis. (Sternberg)

In certain patients affected with this form of tuberculosis, we have seen that the prominent symptoms are due to compression of one or more of the large vessels in the chest. Compression of these vessels, and consequent retarded circulation, may be confidently referred to enlarged bronchial glands, since aneurism, carcinomatous or other tumors, which would produce a similar result, are very rare before puberty. Sometimes the diagnosis is rendered certain by the physical signs observed by auscultation, and percussion over the sternum and the interscapular space. The condition of the external glands should also be observed, as those of the axilla, neck, and groin.

The diagnosis of pulmonary, though more readily made than that of intracranial and bronchial tuberculosis, is often difficult and uncertain. This is, in part, explained by the fact that the tubercles are so frequently disseminated, while emaciation and a chronic cough are not infrequent from other causes than tubercles. Rachitis, intestinal worms, dentition, simple tracheal or bronchial inflammation, may be attended both by a chronic cough and emaciation. Caution is therefore requisite in order to avoid a grave error in diagnosis. Precipitancy in the diagnosis of doubtful cases is worse than indecision, and it is often best to postpone an expression of opinion as to the nature of the disease, till the case has been observed a few days.

The significance and importance of the symptoms, physical signs, and other facts on which a diagnosis must be based, have already been sufficiently pointed out. It is difficult, in fact in certain cases impossible, to discriminate by the physical signs between simple cheesy pneumonia and cheesy pneumonia which has ended in the formation of tubercles. The patient has an attack of catarrhal pneumonia; but, instead of absorption of the inflammatory product, cheesy infiltration occurs, and the lung in places becomes infiltrated with pus, softens, and breaks down. The patient presents the symptoms and physical signs of phthisis. He may recover after a protracted sickness, or may die. The disease may remain a pneumonia; but this is a condition of the lungs which favors the development of tubercles, and in a certain proportion of cases tubercles do form in the last weeks of life. Though the differential diagnosis in such cases between cheesy pneumonia and tuberculosis supervening on pneumonia is impossible, practically the discrimination is unimportant, as the same treatment is required.

Advanced pulmonary tuberculosis, except when it supervenes upon pneumonia, can in most instances be readily diagnosticated by a careful examination. Still, it is to be recollected, as already pointed out, that certain of the symptoms and physical signs, which occurring in the adult would afford almost positive proof of pulmonary tuberculosis, not infrequently have a different origin in children.

The diagnosis of tubercles in the abdominal organs is facilitated by the presence of symptoms which indicate at the same time tuberculosis of the lungs. Among the chief diagnostic signs of tuberculosis of the peritoneum may be mentioned meteorism and a degree of tenderness on pressure, but there is danger of mistaking the tympanitic state of the intestines common in ill-nourished infants and the rachitic, or the fulness due to enlarged spleen or liver, for that occasioned by peritoneal tuberculization, and *vice versa*. The history of the case, and a careful examination of accompanying symptoms, and the shape and feel of the addomen, usually suffice to establish the diagnosis. In simple gaseous distention of the abdomen there is an absence of the symptoms, general and local, which attend tuberculosis; rachitis occurs at an earlier age than peritoneal tuberculosis, and digital examination, aided by percussion, enables us to diagnosticate enlargement of the liver or spleen.

Tubercular enlargement of the mesenteric glands cannot be positively diagnosticated when they are small. When they have attained such a size that they can be felt through the abdominal walls, palpation, in

connection with the history and symptoms of tuberculosis, suffices to establish the diagnosis. The glandular tumors can be diagnosticated from other tumors by the fact that they are tender on pressure, and occupy the umbilical region, while fecal tumors are not tender, and are located in the iliac or lumbar region. Gastro-intestinal tuberculosis cannot be positively diagnosticated. Protracted diarrhœa, or frequent attacks of diarrhœa, not readily controlled by medicine, and occurring in tubercular cases, are probably associated with intestinal ulceration; but in only a certain proportion of cases of ulceration are there also tubercles in the walls of the intestines, as we have seen above.

PROGNOSIS.—Death is the ordinary result of tuberculosis in the child, as it is in the adult; but now and then one recovers. Hospital statistics show that the average duration of the disease is from three to seven months. Under favorable circumstances it is more protracted, even to two or three years. Those succumb soonest who inherit a strongly marked tubercular diathesis, live in damp, dark, and ill-ventilated apartments, and whose diet is scanty or of poor quality. Therefore in the poor quarters of the city tuberculosis presents a worse form and pursues a more rapid course than among families in better circumstances.

Favorable prognostic signs are absence of tubercular diathesis, good appetite and general health, with little emaciation, infrequency of cough, with respiration, pulse, and temperature nearly normal. Such symptoms may afford hope of recovery with judicious regimenal and therapeutic measures. On the other hand, if the symptoms be grave, death is inevitable, unless in bronchial phthisis, in which, even when there is considerable urgency of symptoms, the offending gland is sometimes eliminated by softening and ulceration, and the patient improves temporarily, if he do not ultimately recover. Complete and permanent recovery is, however, quite exceptional.

Death in tuberculosis of children may occur from exhaustion induced by the general disease, or from the local effects of the tubercles. Thus, in intracranial tuberculosis it may result from meningitis ending in convulsions and coma; in pulmonary tuberculosis, from dyspnœa, though more frequently from exhaustion; in that of the bronchial glands, from dyspnœa or hemorrhage; in that of the abdominal organs, from peritonitis or protracted diarrhœa.

TREATMENT. *Prophylactic.*—Since caseous substance occurring in some part of the system is a common cause of the development of tubercles, it is evident that measures which tend to prevent the occurrence of this substance are prophylactic of tuberculosis; and since, in children, cheesy matter, in most instances, is a product of strumous inflammations, the anti-strumous remedies are demanded in the prophylactic as well as curative treatment of tuberculosis. Therefore, the strumous child should be watched with great care, and such measures be employed as are calculated to invigorate his system. If the mother belong to a decidedly tubercular family, or give the history of scrofula in her childhood, it is better that she do not suckle her infant, but employ a healthy wet-nurse. Children who are weaned should have plain, but nutritious and easily digested diet, a part of which should

be milk. Residence in an airy and salubrious locality, outdoor life, a scrupulous avoidance of exposure by which cold might be contracted, are important, in order to the continued latency of the diathesis.

Loss of flesh or appetite, or other evidences of failing health, indicate the need of other measures of a therapeutic character. Alcoholic stimulants should now be allowed three or four times daily in milk: cod-liver oil, with half its quantity of syrup of the lactophosphate of lime, to which the syrup of the iodide of iron is added, will be found useful for these cases, as it is in the ordinary forms of scrofula. The various bitter preparations containing iron, as the citrate of iron and quinine, elix. calisaya bark with iron, etc., should be employed, when, for any reason, cod-liver oil is not tolerated. By the employment of such precautionary measures as soon as indicated, multitudes of children might be saved from tuberculosis who now perish.

Curative.—The medicinal agents which are required in ordinary cases have been already mentioned, namely, cod-liver oil, iron, sometimes the vegetable tonics, and alcoholic stimulants. The oil may be given in emulsion to disguise the unpleasant flavor, or, which I prefer, mixed with half its quantity of syrup of the lactophosphate of lime, as recommended for the treatment of scrofula.

If the cod-liver oil be not tolerated, or if it impair the appetite, it should be discontinued. In cases of diarrhœa it is of little or no benefit and may do harm. Under such circumstances patients sometimes do better with simple regimenal measures, aided by alcoholic stimulants, and one of the least unpleasant of the tonics, as wine of iron or the calisaya bark. The regimen already recommended for prevention is also required as part of the curative treatment.

Certain modifications of treatment are demanded on account of the localization of the tubercles. Intracranial tuberculosis, as soon as diagnosticated, should be treated by pretty decided doses of iodide of potassium, though, unfortunately, there is little prospect of improvement. The glandular disease, whether bronchial or mesenteric, requires the iodide of iron, with or without that of potassium. Pneumonitis or pleuritis, so frequent a complication of pulmonary tuberculosis, requires emollient poultices, with moderate counter-irritation, and the judicious use of opiates with stimulants. The peritonitis occurring in abdominal tuberculosis, which is usually circumscribed, is best treated by fomentations and poultices, with opiates, and the diarrhœa by subnitrate of bismuth and chalk, five to ten grains of each, or the bismuth with Dover's powder, or a more active astringent.

CHAPTER IV.

SYPHILIS.

SYPHILIS in infancy and childhood presents itself under two forms, namely, the congenital and acquired; the former is the more frequent.

ETIOLOGY.—Congenital syphilis may be derived from either father or mother. Either parent, having previously had syphilis, may transmit it to the offspring, although at the time free from syphilitic symptoms. The mother, healthy at the time of conception, but infected with syphilis prior to the eighth month of gestation, may communicate the disease to the fœtus; syphilis contracted in the eighth or ninth month does not affect the fœtus. If both parents have syphilis, the infant is almost necessarily syphilitic; on the other hand, if only one parent be affected, the infant may or may not be contaminated. Sometimes, with such parentage, a part of the children are syphilitic, and a part healthy.

Acquired syphilis in infancy and childhood may be received through primary lesions—that is, by reception of the virus from a chancre or bubo; or it may be derived from certain of the secondary lesions. Inoculation by primary lesions may occur at the birth of the infant, from a syphilitic sore in the vagina or upon the vulva of the mother; inoculation in this manner is, however, rare. Children may also receive the virus from primary lesions on the persons of nurses or companions. Infection in this manner is sometimes accidental, and sometimes the result of criminal conduct. A chancre on the breast of the wet-nurse not very infrequently communicates syphilis to the nursling.

The contagiousness of "secondary manifestations," for a long time doubted, is now fully established. Syphilis may be communicated by the secretion or exudation of a mucous patch, or a secondary sore. Hence the danger of lactation by unhealthy wet-nurses, though they present no symptoms of recent syphilis. Excoriations or sores upon the nipple or breast of an infected wet-nurse may communicate the disease to the nursling; and, on the other hand, mucous tubercles or fissures upon the lips or tongue of the infected infant may be the means of contaminating a healthy wet-nurse. Many such cases are now contained in the records of medicine. Vaccination by means of the scab is also a mode by which constitutional syphilis may be communicated. For further particulars in reference to this subject the reader is referred to our remarks on vaccination.

The specific principle of syphilis is unknown. Klebs obtained by cultivation bacilli from rods and spherules which he found in indurated chancres. With the cultivated bacilli he produced a local affection by inoculation in the monkey, which resembled, in some respects, that of syphilis, and in other respects that of tuberculosis. Ziegler and von Rinecker obtained negative results from similar experiments. (Ziegler's *Path. Anatomy.*)

Clinical History.—The effects of the syphilitic poison upon the development of the fœtus, and the development and health of the infant, are different in different cases. The fœtus, under the influence of the poison, often ceases to grow, shrivels, dies, and is expelled, long before term; or it may be born alive, but prematurely, and showing clear evidences of the disease, as soon as it comes into the world; or, again, it may be born at term, but dead. So frequently is syphilis a cause of non-viability, that, as Trousseau has remarked, this disease should be suspected as the cause, whenever a woman repeatedly aborts. Abortion from syphilis commonly occurs at or about the sixth month of gestation. In those cases in which the fœtus dies from syphilis there is often placental syphilitic disease, namely, an undue growth of cells in the villi, which, compressing the vessels, gives rise to fatty degeneration, and prevents the requisite interchange between the maternal and fœtal blood. (Harring, Frankell.) Frankell designated the change "granulation-cell hypertrophy of the placental villi." Virchow, in one case found a gummy tumor in the maternal portion of the placenta.

When a fœtus destroyed by syphilis is expelled, it is apt to present a macerated appearance, the cuticle being detached over large patches of surface, and in other parts raised in blebs, with a thin, puriform, and offensive fluid underneath; the liver is occasionally indurated, and abscesses with spots of inflammation are sometimes observed in the thymus gland; the amniotic fluid is offensive, turbid, and of a greenish or greenish-brown appearance.

If the fœtus, in which syphilitic manifestations have begun to occur, have reached a viable age, and be born alive, it is small and imperfectly developed, often shrivelled and senile in appearance. The skin looks unhealthy, and it may exhibit a distinct rash. Bouchut saw a seven and a half months' infant born alive, with an eruption of a copper color upon the legs and arms, and onyxis upon the fingers and toes. The bullæ of pemphigus are also not infrequent upon the skin at birth, or they appear within a few days, two or three, after birth. The smallest are about the size of a split pea; but many are considerably larger; the largest consist of two or more which have coalesced. They contain a thin, greenish, purulent matter, and appear most frequently upon the palms of the hands and soles of the feet, but also in severe cases upon the face and over the surface of the body. Recently I was able to diagnosticate syphilis in an infant within a day after birth, by its small size and feebleness, and the appearance of large blebs of pemphigus upon its hands, feet, fingers, and toes, over which the skin soon broke, leaving troublesome and bleeding sores; coryza commenced about the twelfth day. The parents seemed healthy, but I was enabled to trace the syphilitic taint to the mother. Non-syphilitic pemphigus, the result of cachexia, sometimes appears soon after birth, but its primary and usual seat is around the neck and upon the body. I have known it to appear within the first week of life, and end fatally by the close of the second week. I have not found it difficult to distinguish it from syphilitic pemphigus by the history of the family, and its absence from the palmar and plantar surfaces of the hands and feet. Condylomata, mucous patches, and stains of a copper color are the principal syphilitic

affections, besides pemphigus, which have been observed at birth on the bodies of contaminated infants. It is stated that M. Cullerier, in ten years' attendance at the Hôpital de Lorraine, met only two cases of syphilitic manifestations at birth, and Victor de Meric only two cases in forty-six infants, who were affected with congenital syphilis (Bumstead); but in the practice of others a larger proportion have exhibited symptoms at birth. Ordinarily the period in which congenital syphilis is first revealed by symptoms is between the fifteenth and fortieth days. Rarely the manifestation of the disease is delayed several months. M. Diday ascertained the time of the commencement of symptoms in 158 cases as follows:

Before the completion of one month after birth, in	86
Before the completion of two months after birth, in	45
Before the completion of three months after birth, in	15
At four months	7
At five months	1
At six months	1
At eight months	1
At one year	1
At two years	1

In cases of tardy commencement of syphilitic symptoms it is probable that the poison has been partially eradicated from the affected parent by appropriate treatment.

The nutrition of the infant who has inherited the syphilitic taint, but does not exhibit it at birth, is for a time good, but it begins to be impaired when the local manifestations of syphilis appear, or soon after. The system gradually wastes; the skin loses its fresh and healthy appearance, and becomes sallow, and, after a time, more or less wrinkled; the features become pinched and contracted, and wear a sad expression. M. Diday says: "Next to this look of little old men, so common in new-born children doomed to syphilis, the most characteristic sign is the color of the skin." Trousseau thus describes this discoloration of the surface: "Before the health becomes affected, the child has already a peculiar appearance; the skin, especially that of the face, loses its transparency; it becomes dull, even when there is neither puffiness nor emaciation; its rosy color disappears, and is replaced by a sooty tint, which resembles that of Asiatics. It is yellow, or like coffee mixed with milk, or looks as if it had been exposed to smoke; it has an empyreumatic color, similar to that which exists on the fingers of persons who are in the habit of smoking cigarettes. It appears as if a layer of coloring had been laid on unequally; it sometimes occupies the whole of the skin, but is more marked in certain favorite spots, as the forehead, eyebrows, chin, nose, eyelids—in short, the most prominent parts of the face; the deeper parts, such as the internal angle of the orbit, the hollow of the cheek, and that which separates the lower lip from the chin, almost always remain free from it. Although the face is commonly the part most affected, the rest of the body always participates more or less in this tint. The infant becomes pale and wan."

The infant whose system is profoundly affected by syphilis rarely smiles, and its voice is feeble and plaintive; its frequent, whimpering cry is quite characteristic.

Coryza is one of the earliest and most constant of the local affections in infantile syphilis. It is slight at first, attracting little attention on the part of the parents, who are not aware of its significance, and usually attribute it to a slight cold; but it gradually increases. It gives rise to a secretion from the Schneiderian membrane, at first thin, but which becomes more consistent, and is attended by the formation of scabs. The thickening of the mucous membrane, in consequence of the inflammation and the presence of crusts, narrows the passage through the nostrils so as to produce snuffling respiration, and sometimes render nursing difficult. In severe cases respiration through the nostrils is almost wholly prevented, so that death may occur from inanition, unless the breast be milked into the infant's mouth, or it be fed with a spoon; but, ordinarily even in grave coryza, it continues to nurse, though obliged often to release its hold of the nipple to obtain breath. It is when coryza begins to interfere with lactation that it first alarms the parents. The inflammation at the same time may affect the throat and larynx, causing hoarseness of the voice. Ulceration of the Schneiderian membrane and the adjacent cartilage or bone is rare in infancy or childhood, although cases occur which are even attended with more or less flattening of the nose. Diday believes that the discharge which accompanies coryza is in great part due to mucous patches developed on the Schneiderian membrane. The upper lip, over which the discharge flows, becomes red, excoriated, and more or less incrusted. The coryza, in most cases, coexists with other local syphilitic affections. Occasionally it occurs alone, and is the only evidence of the presence of the specific taint, except such as is afforded by the malnutrition and general appearance of the patient.

Mucous patches occur in most patients. They are developed either upon the mucous surfaces, or upon parts of the skin which are thin and exposed to friction, and such as are moistened by secretion or transudation from the vessels underneath. The most common seat of mucous patches is at the termination of mucous canals; but in infancy, on account of the peculiar delicacy of the skin, they may occur upon almost any part of the cutaneous surface. They are most common, however, around the anus, upon the vulva, scrotum, umbilicus, labial commissures, in the axillæ, and behind the ears.

Mucous patches upon the skin present a rounded border, and are slightly elevated. Their color has been compared to that of skin which has been softened by the prolonged application of a poultice. Erosions and cracks sometimes occur in the patches, from which a thin liquid exudes.

Upon mucous surfaces they are less elevated than upon the skin, and are prone to ulcerate. These ulcerations, commencing at the centre, extend, and soon the mucous patch disappears, and its site is occupied by an ulcer. The ulcer may be circular, oval, elliptical, crescentic or irregular. The arches of the fauces are a common seat of mucous patches.

Roseola is an occasional symptom of infantile syphilis. "It is distinguished," says Diday, "by patches of a bright rose-color, circumscribed, irregularly rounded, of various sizes (most frequently about as

large as one of the nails); appearing, by preference, on the belly, lower part of the chest, neck, and inner surface of the extremities." The spots do not readily and fully disappear by pressure.

PEMPHIGUS appearing soon after birth has already been alluded to. Its most frequent seat, whether occurring at birth or as a subsequent manifestation, is, as we have stated, the palms of the hands, soles of the feet, the fingers, and toes. This eruption commences by a violet tint of the skin, and in the course of twenty-four to forty-eight hours a watery fluid collects underneath, which soon becomes turbid. The skin peels off, and sometimes an angry sore results, which bleeds readily when rubbed or pressed. In other and more favorable cases new skin takes the place of that which is lost. Pemphigus at birth is a precursor of death, but when it appears for the first time some weeks after birth, it is a less unfavorable prognostic sign. In cases of recovery it disappears, with proper treatment, in two or three weeks.

ACNE, IMPETIGO, and ECTHYMA are occasionally observed in children afflicted with syphilis. The indurated pustules of acne occur most frequently upon the shoulders, back, chest, and buttocks. The pus is sometimes absorbed, and in other cases discharged, leaving a small cicatrix, which, after a time, disappears. Impetigo appears most frequently upon the face, and occasionally upon the chest, neck, axilla, and groin. Unlike simple impetigo, the syphilitic impetiginous eruption is surrounded by a copper-colored areola, Ecthyma occurs upon the legs and buttocks chiefly. It commences as violet-colored spots, which are soon transformed into pustules. Ulcers succeed, which, in reduced states of the system, are apt to enlarge and endanger the safety of the child. Of the three pustular eruptions, acne, according to Diday, is the least serious—indicating a "less confirmed diathesis." Ecthyma is the most serious, on account of the reduced state of the system with which it is usually associated. Syphilitic papulæ and squamæ are rare in infants, but cases have been observed. Onychia occasionally occurs, though less frequently than in syphilis of the adult.

VISCERAL LESIONS.—The visceral lesions which result from the syphilis of infancy and childhood are, suppuration in the thymus gland; gummy tumors in certain organs, most frequently the lungs and liver; increase of the connective tissue of the liver, known as syphilitic cirrhosis; partial perihepatitis, with depressions resembling cicatrices on the surface of the liver; peritonitis; periostitis, with thickening of the bone and exostosis.

Suppurative inflammation in the thymus gland is not common, or has not been frequently observed. When it is present the gland sometimes presents its normal appearance externally, and the abscess is only discovered by incisions. Gummy tumors are white and spheroidal; some are as small or smaller than a pin's head, while others are as large as a pea, or even a hazel-nut. I have seen a considerable number of them not as large as a pin's head, in the liver of an infant. Gummy tumors, according to Lebert, consist "of loose fibrous tissue, made up of pale, elastic fibres, enclosing in their large interspaces a homogeneous granular substance, the elements of which are less adherent to each other than in deposits of true tubercle." Lebert also, with other microscopists, dis-

covered round granular cells in these tumors. According to Robin, gummy tumors "are made up of rounded nuclei belonging to fibro-plastic cells, or *cytoblastions;* of a finely granular, semi-transparent, and amorphous substance; and, finally, of isolated fibres of cellular tissue, a small number of elastic fibres, and a few capillary bloodvessels."

Constitutional syphilis is one of the principal causes of waxy degeneration, and the spleen and liver of infants may be enlarged from this cause. Dr. Samuel Gee has expressed the opinion that in half the cases of hereditary syphilis the spleen is enlarged. (London *Lancet*, April 13, 1867.)

Infiltration of the liver by fibrous substance was first noticed by Gübler. It is not common in the infant. A specimen, showing this lesion, was presented to the London Pathological Society in 1866, by Dr. Samuel Wilks. The following remarks by Dr. Wilks convey a good idea of the appearance and state of the liver in syphilitic cirrhosis: "Having dissected the bodies of several infants who have died of congenital syphilis, I have found fatty livers, and an inflammation of the capsule; but in only two have I discovered adventitious products of a fibrous character. The present example, however, corresponds in every particular with the disease described by Gübler. It must be distinguished (at least as far as the naked-eye appearance reaches) from syphilitic disease of adults, of which many specimens have been before the Society. In these the organ is cicatrized on the surface, and contains distinct nodules of fibrous tissue; while in the disease of children, as in the present specimen, the whole organ is infiltrated by a new material, and it consequently becomes, as described by Gübler, hypertrophied, globular, and hard, resistant to pressure, and even when torn by the fingers, its surface receives no indentation from them; it is also elastic, and when cut, creaks slightly under the scalpel. This was the form of disease in the present specimen. It came from a syphilitic child, a month old, in whom the liver could be felt enlarged during life, and when removed weighed a pound and a half. It was smooth on the surface, and so hard that it resembled rather a fibrous tumor than a liver. It is seen that the liver in the syphilitic child is liable to three distinct pathological processes, namely, gummy tumors, cirrhosis or fibroid degeneration, and waxy degeneration."

Syphilitic perihepatitis and periostitis are more rare in infancy and childhood than in adult life, but they occasionally occur. The late Sir James Y. Simpson considered peritonitis in the fœtus one of the results of syphilis, and a cause of its death.

Osseous Lesions.—Within the last few years, important discoveries have been made in regard to the effect of syphilis upon the nutrition of the bones in children. In 1870, Dr. Wegner, of Berlin, published his observations of the state of the skeleton in twelve syphilitic children, who were either stillborn, or who died within a few days or weeks after birth. He found clear proof that the syphilitic dyscrasia very frequently disturbs the nutrition and produces anatomical changes in the skeleton of the fœtus. The following are the lesions, clearly referable to syphilis, which he observed: periostitis of long bones, including the ribs; softening, separation, and sometimes crepitation, at the point of union of dia-

physis and epiphysis; chalky concretions and infiltrations along the line of ossification; fatty degeneration of marrow; irregular formation and distribution of spongy substance in the epiphysis. These lesions were not all observed in each case, but they occurred with such frequency that there could be no doubt that they were due to the syphilitic taint of system. Confirmatory observations also, in twelve cases, have since been made by Waldeyer and Köbner.[1]

Again, there is a syphilitic lesion of the bone in children, which is not usually present or has not usually been observed at birth, but is developed in the first weeks or months of infancy. The lesion alluded to is a circumscribed enlargement of one or more bones. This has been most frequently observed upon the long bones, including the clavicle and ribs; but in certain children it occurs upon other bones in addition. In some cases it is one of the first manifestations of hereditary syphilis, occurring even sooner than the coryza, while in others several months elapse before it appears. In one case, reported by Dr. Bulkley,[2] of this city, it was first seen only a few days after birth, being perhaps congenital; while in another case, in which the enlargement was upon certain phalanges, and which is represented in the accompanying figure, it appeared at the age of twelve months. When it occurs upon a phalangeal bone, it is designated *dactylitis syphilitica*.

FIG. 22.

The enlargement, if upon a long bone, ordinarily begins at or near the point of union of the diaphysis with the epiphysis. It is located upon the extremity of the shaft which it encircles, and it extends over

[1] See elaborate paper by R. W. Taylor, M.D., New York Journal of Obstetrics, etc., July, 1874.

[2] Rare Cases of Congenital Syphilis, New York Med. Journal, May, 1874.

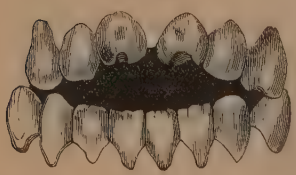
a part or nearly the whole of the epiphysis. It has an elevation of perhaps one-half or three-quarters of an inch in typical cases; its surface is smooth, or slightly undulating, and the skin over it, though distended, has its normal appearance, and is easily movable, unless ulcerations have occurred.

These enlargements, which result from the specific inflammation, occurring in the periosteum and the bone, may resolve under proper treatment; but if neglected, and the antihygienic conditions are bad, degenerative changes may occur, ending in ulceration and destruction of the diseased part to a greater or less extent.

Though these bone enlargements, whenever observed, should excite suspicions of syphilis as the cause, enlargements which present the same general appearance do occur from other causes. Such a case was observed by me in the children's class in the Outdoor Department of Bellevue, and Dr. Bulkley details another case in his paper. In the case observed by me, the inflammation and enlargement seemed to be strumous. Bäumler says: "Dactylitis syphilitica does not always originate in the bone; similar appearances may be produced through gummous formation in the sheaths of the tendons, and in the fibrous structure of the finger;" and again, "Its outward appearance may be produced also by tuberculosis, enchondroma, or sarcoma of the bone-marrow." (Art. Syphilis, *Ziemssen's Encycl.*)

Mr. J. Hutchinson, of London, has called attention to the fact that hereditary syphilis, having perhaps been manifested by the usual symptoms during infancy, and then becoming latent, may give rise to new symptoms after the fourth year. The most noticeable of these symptoms is a dwarfing of the permanent incisor teeth, which are rounded and peg-like, and their enamel notched at the free ends of the teeth. On account of the small size and shape of the teeth, there are interspaces between them. This abnormal development is most marked in the central incisors of the upper jaw, and in certain cases it is limited to them, and it never appears in the other incisors unless it does also in them. Another symptom, which only appears in hereditary syphilis, is an interstitial keratitis occurring on both sides, and attended by the deposition of fibrin in the substance of the cornea. In a few weeks the inflammation declines, but a slight opacity of the cornea remains. The cerebral nerves may become affected, usually a single pair—if the auditory, deafness resulting; if the optic, dimness of sight. Occasionally there are other manifestations of syphilis in this period, as enlargement of spleen and liver, and nodes upon the long bones.

Fig. 23.



Prognosis.—This depends in great part on the general condition of the patient. If there be much emaciation, and the symptoms indicate a deeply seated cachexia, a considerable proportion perish. On the other hand, if the general health be not greatly impaired, although the local affections are pretty severe, the prognosis with correct treatment is good. The younger the infant, when the symptoms of syphilis appear, the more unfavorable, as a rule, is the prognosis.

TREATMENT.—Parents who beget syphilitic children ought, from a due regard for their offspring, to make use of antisyphilitic remedies, although they present in their persons no evidences of syphilitic taint. A good prescription for the parents is one-sixtieth of a grain of corrosive sublimate in the compound tincture of bark, given twice or three times daily for several weeks. If the father have had syphilis, both parents should be subjected to this treatment, and it may be continued, at least on the part of the mother, during the first months of her gestation. So small a dose of the mercurial does not, in my opinion materially increase the liability to miscarry. There is much more danger of miscarrying from allowing the syphilitic taint to remain uncontrolled. Some prefer the use of mercurial ointment in the treatment of pregnant women for syphilis, in the belief that it is less likely to produce abortion. It is used for this purpose in the proportion of one drachm to the ounce. It is equally effectual in the eradication of the syphilitic taint with the small dose of corrosive sublimate recommended above for internal administration; but it is impossible to determine the quantity of mercury which enters the circulation when inunction is employed, and salivation is more likely to occur.

Syphilis in the infant requires mercurial treatment as in the adult. Mercury may be employed internally or by inunction. Some prefer inunction in the treatment of ordinary cases in the manner recommended by Sir Benjamin Brodie. I have spread," says he, "mercurial ointment, made in the proportion of a drachm to an ounce, over a flannel roller, and bound it round the child once a day. The child kicks about, and, the cuticle being thin, the mercury is absorbed. It does not either gripe or purge, nor does it make the gum sore, but it cures the disease. I have adopted this practice in a great many cases, with the most signal success." Trousseau, on the other hand, discountenances the use of inunction, as mercurial ointment applied to the skin produces irritation, and increases the suffering and restlessness of the child. He prefers the following solution, which is known as Van Swieten's, for internal treatment:

℞.—Hydrarg. bichlorid. . . . . 1 part.
Aquæ . . . . . 960 parts.
Spts. rectific. . . . . 100 parts.—Misce.
Dose.—One, or at most two grammes (15.434 to 30.868 grains), in milk, daily.

In order to avoid the risk of establishing a diarrhœa, and to leave the stomach free for the employment of other medicines, as cod-liver oil and the iodide of iron, I prefer and commonly prescribe for infants inunction with the mercurial ointment diluted with eight times its quantity of lard, cold cream, or vaseline. It should not be applied as a plaster, but a quantity of the size of a large chestnut should be rubbed three times daily upon the neck or breast of an infant of three or four months. For children over the age of eight or ten months, Van Swieten's, or one of the following formulæ may be employed:

℞.—Hydrarg. cum cretâ . . . . . gr. iij–vj.
Sacch. alb. . . . . ℈j.—Misce.
Divid. in chart. No. xii. One powder three times daily.

℞.—Hydrarg. chlor. corros. . . . . gr. ss–j.
Syr. sarsæ comp. . . . . ℥ij.
Aquæ . . . . . ℥viij.—Misce.

Dose.—One teaspoonful three times daily.

℞.—Hyd. chlor. corros. . . . . gr. ss.
Potas. iodid. . . . . ℥j.
Ferri et ammon. citrat. . . . . ℥j.
Syr. simplic. . . . . ℥vj.—Misce.

Dose.—One teaspoonful three times daily for a child of 3 to 5 years.

℞.—Hyd. chlor. corros. . . . . gr. j.
Potas. iodid. . . . . ℥ij.
Syrup. simplic.,
Aquæ . . . . . āā ℥ij.—Misce.

Dose.—Six drops three times daily for a child of 3 months.

Mercury, in whatever way employed, should not be discontinued entirely till several weeks after the syphilitic symptoms have disappeared; it is proper to continue it for a time, in diminished quantity and fewer doses, after the health seems fully restored.

When the mercurial is omitted, tonics are often required. The preparations of cinchona are useful in certain cases, as are also those of iron. If the patient remain feeble and pallid, presenting evidences of struma, cod-liver oil and syrup of the iodide of iron will be found beneficial continued for some weeks or months after the mercury is discontinued. Attention should always be given to cleanliness and the hygienic management of the patient. In some instances direct treatment of the local affections is serviceable. To aid in the cure of syphilitic coryza, the following ointment should be applied within the nostrils by a nasal sponge three times daily:

℞.—Ung. hydrarg. nitratis . . . . . ℥ij
Ung. zinci oxidi . . . . . ℥ij.—Misce.

Recently I have been in the habit of employing Squibb's oleate of mercury, two per cent., for syphilitic coryza of infants, and the effect has been satisfactory. It may also be employed by cutaneous inunction in the treatment of the general disease.

Condylomata or mucous patches seated upon the cutaneous surface should be dusted with calomel. At my clinique, in April, 1871, a child two years and ten months old was presented, with a large condylomatous outgrowth near the anus. The history of the child showed that in all probability the disease had been contracted within a year from syphilitic children in one of the public institutions. Within three weeks this affection disappeared by dusting upon it calomel once daily, with appropriate internal treatment.

An infant under the age of twelve months should have breast-milk, and if it present symptoms of syphilis, and the mother who suckles it or the wet-nurse have none, she should be warned of the danger, and should watch for any abrasion upon her nipples. If an abrasion occur through which her system might be infected, or even without an abrasion, it will be safer to wash the nipples after each nursing with a mild solution

of corrosive sublimate. The infant should be kept clean by bathing it in tepid water twice daily, and excoriations upon its lips or mucous patches should be bathed before the nursing with some mild disinfectant solution, as boracic acid. The best possible hygienic conditions should be provided for the infant, since cachexia is commonly present. It should be taken out-door frequently in suitable weather, and its removal from the city to the country, especially in hot weather, may be advisable. If the mother be syphilitic, her milk may be too thin and deficient in nutritive properties, and if so, its use should be supplemented by artificial feeding, or a wet-nurse should be procured. The cachexia which remains after the disappearance of the syphilitic manifestations requires the use of tonics, as cod-liver oil and syrup of the iodide of iron.

Syphilitic symptoms may reappear during childhood. The exanthemata rarely appear at this age when the proper treatment has been employed in infancy, but condylomata and gummy tumors may, and they require a return to the mercurial treatment. If the bones are affected, the iodide of potassium is the proper remedy. It causes manifest improvement in the disappearance of the periosteal pains and swelling.

SECTION II.

ERUPTIVE FEVERS.

CHAPTER I.

MEASLES.

THE disease known in the vernacular as measles has also the names rubeola and morbilli. It is a common exanthematic affection, occurring at any age, but most frequently in childhood. It affects once the majority of mankind. Writers recognize three stages of measles: first, that of invasion, which ends with the appearance of the eruption; secondly, the eruptive stage; and, thirdly, the stage of decline or desquamation.

ETIOLOGY.—Micrococci have been found in the blood of rubeolar patients by Coze and Feltz. Keating also discovered them during an epidemic of malignant measles (*Phila. Med. Times*, Aug. 12, 1882), and Ransome, Braidwood, and Vacher found them in the breath of patients, as well as in their tissues (*Brit. Med. Journ.*, Jan. 21, 1882). It seems probable that they are the specific principle; if so, they remain dormant in the system about twelve days, which is the incubative period.

SYMPTOMS.—This disease commences with such symptoms as usually occur in mild but pretty general inflammation of the air-passages, namely, cough, fever, anorexia, and thirst. The eyes present a suffused, moderately injected, and brilliant appearance, and the buccal and faucial surfaces are injected. The Schneiderian membrane, and that lining the larynx, trachea, and bronchial tubes, participate in the increased vascularity. The cough at first is dry, and sometimes distinctly croupy. Catarrhal or false croup, indeed, is not infrequent in the initial period of measles. The cough is attended by slight acceleration of respiration, and by little or no pain in the respiratory movements. If auscultation be practised at this early stage, we observe the vesicular murmur, somewhat harsh in character, and sometimes sonorous and sibilant râles. A little later, râles of a moist character appear.

The patient, if old enough, commonly complains of headache, and of dull pain in the epigastric region, or the centre of the sternum, due to the bronchitis. With these local symptoms febrile reaction occurs. The temperature rises to about 102° or 103°, as indicated by the thermometer in the axilla. The pulse numbers from 110 to 130 per minute. The febrile movement is greater than in primary tracheo-bron-

chitis, except when the bronchitis extends to the bronchioles, but it is less than in most cases of scarlet fever.

The fever in the premonitory stage of measles after the first day is not uniform. It is attended by remissions and exacerbations, the former occurring in the first part of the day, the latter in the evening. Sometimes two exacerbations occur in the day. The face is flushed and somewhat swollen, especially during the times of increase in the fever, and the child is drowsy or restless. Vomiting, so common a symptom in the commencement of scarlet fever, occasionally occurs in measles. While in scarlet fever this takes place in the first twenty-four hours, in measles it takes place with about equal frequency at any period previously to the eruption. It was present during the first stage, sometimes almost as late as the eruptive period, in thirteen, and was absent in twenty-three cases, in which I preserved records in reference to this symptom.

The duration of the first stage varies in different cases. It is usually from two to five days, with an average of about four. Occasionally it is more protracted on account of some disturbance in the economy, either from exposure to cold or other cause, which prevents the necessary afflux of blood toward the surface, and retards the eruption. In eighteen cases in my practice in which the duration of the cough previously to the appearance of the rash was accurately ascertained, the time varied from one to five days, with an average of three and one-third; in ten other cases it had continued, the parents stated, about a week, and in five, from one to two weeks, previously to the eruption.

The eruption commences, when the disease pursues its normal course, upon the forehead and neck, then the face, and gradually extends downward, occupying from twenty-four to thirty-six hours in passing over the trunk and limbs. It appears first as indistinct red points, not more than a line in diameter, which increase in size and become more distinct. Their borders are uneven or irregular, or they are finely notched; their general shape is, however, circular, except as two or more unite, when they may assume any form. The crescentic form which writers describe is due to the union of two points of eruption. The largest of these spots, when there is no coalescence, do not exceed a quarter of an inch in diameter, and many are much smaller. Frequently in plethoric children, if there be much fever, there is continuous redness over several inches of surface. The eruption is then confluent. This form is often observed upon parts of the surface where the capillary circulation is most active, when it is discrete elsewhere. In some of these cases, diagnosis of measles from scarlet fever is attended with difficulty.

The rubeolous eruption is slightly elevated, the elevation not being appreciable to the sight, but it can be ascertained by passing the finger over the skin, when roughness is felt at the point of eruption. Sometimes the elevation, especially in the commencement of the efflorescence, is not appreciable, even to the touch. The eruption is broad and flat, never acuminate, never changing its form to the vesicular or pustular. It disappears by pressure, and immediately reappears when the pressure is removed. It has been compared in appearance to flea-bites. Small, pointed, papular, vesicular, or pustular eruptions are sometimes seen in

connection with those of measles, but they are accidental, occurring in other states of system, as well as in measles, if there be the same augmented temperature.

In the commencement of the eruptive period the severity of the constitutional and local symptoms increases. The pulse and temperature correspond with the character which they presented during the exacerbations of the first stage. The features are slightly swollen; the eyes still watery and sensitive to light; the conjunctiva, ocular and palpebral, and the mucous membrane of the cavity of the mouth and of the air-passages, continue injected. The tongue is covered with a moist thin fur, and its papillæ are prominent, though less so than in scarlet fever. The cough continues frequent, and is seldom attended with much expectoration, in uncomplicated cases; often there is no expectoration whatever. The appetite is lost, but drinks are readily taken on account of the thirst. Diarrhœa sometimes occurs on the first day of the eruption, but it lasts only a few hours, and, if the disease pursue its usual course, abates of itself. With the exception of this the bowels are regular, or a little constipated during the eruptive period.

On the second day of the eruption, or sixth of the fever, the symptoms begin to abate. The pulse is less accelerated, and the temperature diminishes; the cough is less frequent and is easier, and the flushed and swollen appearance of the face declines. By the close of the third or on the fourth day the rash has disappeared in the order in which it extended over the body. There only remain faint maculæ, which in the course of a day or two fade completely.

With the disappearance of the rash the fever nearly or quite ceases, but a slight and painless cough continues for several days.

Occasionally the eruption presents a livid appearance; this is the rubeola nigra of writers. From cases which I have observed, it is my opinion that this should not be considered a distinct species in the vast majority of patients, but that the dark color is due to internal inflammation, usually capillary bronchitis or pneumonia, which prevents full decarbonization of the blood. Rarely rubeola nigra is due to the vitiated state of the blood, or the malignant nature of the disease. The course of the eruption in this form of measles is somewhat different; it continues longer, fades more slowly, and does not disappear so readily on pressure. Traces of it are observed a week or more after its first appearance; it is likely to be fatal. Measles may present this form from the beginning, or, commencing as vulgaris, it may pass into rubeola nigra.

Measles may be irregular in form, but aberrations are less frequent than in scarlet fever. Writers describe measles without catarrh, and, on the other hand, with catarrh but without the rash. But positive diagnosis in such cases must be difficult. It is probable that simple catarrh and roseola have sometimes been mistaken for the two forms of irregularity mentioned; but when a child, in a family of children affected with measles, presents all the symptoms of that disease, except the catarrh or except the eruption, the diagnosis of irregular measles would, as a rule, be correct.

Occasionally the stage of invasion is very short, or even absent. In

one case the parents informed me that the catarrhal symptoms began on the day when the eruption appeared. Convulsions sometimes occur at the commencement of measles, as well as during its progress. A single convulsive attack at the commencement of measles is usually not dangerous; when repeated, it is more serious; it is also more serious when it occurs in the course of measles. In certain patients the eruption appears in an irregular and partial manner, occurring perhaps, at a late period, and indistinctly, upon the trunk alone, or upon the trunk and partially upon the legs. In many cases of deferred or partial eruption there is internal congestion or inflammation of some part, which causes withdrawal of blood from the surface, and thus prevents the normal development of the rash.

When the eruption disappears the third stage commences, that of desquamation. It is characterized by a scanty furfuraceous exfoliation of the epidermis. The desquamation is seldom as great as in scarlet fever, and it occurs most where the eruption has been thickest and the epidermis most inflamed. Exfoliation occurs between the fourth and seventh days after the commencement of the eruption, the eighth and the eleventh of the disease. Frequently it does not take place, or is so slight as not to be observed.

With the disappearance of the rash, the symptoms rapidly abate. The pulse becomes more natural, the temperature is reduced, the digestive organs return to their normal state, and the convalescence is established. The cough continues several days after the other symptoms abate, but it is less and less frequent, and is not painful.

Complications.—The complications of this disease are important. Much of the success of the physician in the management of measles depends upon a correct diagnosis and understanding of them. The most frequent of these complications are bronchitis and broncho-pneumonia. Slight bronchitis is uniformly present in measles, but if it increase so as to cause embarrassment of respiration, and become a scource of danger, it is properly a complication. This complication, as well as pneumonia, may occur at any period of measles; but it commences most frequently in the first stage. Occurring in the first stage, it may prevent the regular appearance of the rash; if in the second, it often causes retrocession of it.

When bronchitis becomes really serious, it usually has invaded the minute bronchial tubes. This disease, designated capillary bronchitis or suffocative catarrh, I have elsewhere described. The clinical history of fatal bronchitis, as a complication of measles, is as follows: The respiration, at first not notably altered, becomes by degrees, accelerated, and the patient more and more fretful. The pulse, instead of becoming less accelerated, as after the first days of simple measles, is daily more rapid, and the respiration more frequent and labored. The dyspnœa gradually increases, the inframammary region is depressed, during each inspiration, and the subcrepitant râle is heard on both sides of the chest. There is, probably, collapse or inflammation of some of the lobules. Finally the prolabia and fingers become livid, and death occurs from apnœa. Capillary bronchitis is diagnosticated from pneumonitis by the physical signs. It is in the young child more dan-

gerous than that disease, unless perchance the latter be double. A large proportion of those affected under the age of three years, die. The anatomical characters of fatal bronchitis occurring in connection with measles, I have had an opportunity to inspect. In an infant who died with this complication in the Infants' Hospital in the spring of 1867, there were evidences of continuous inflammation from the epiglottis to the minutest bronchial tubes.

Pneumonia as a complication does not differ materially from the idiopathic inflammation, except that it is more protracted and fatal. Its form is in most cases catarrhal, resulting from an extension downward of the bronchitis.

The next most frequent serious complication of measles is entero-colitis. This may commence at any period during the course of the disease. If the colon be more especially the seat of inflammation, the evacuations contain mucus and blood, unless in young children, in whom the stools, even in severe colitis, commonly have a green color. The anatomical character of this complication varies in different cases, like the idiopathic form of inflammation. Sometimes there is simple arborescence of the intestinal mucous membrane, with tumefaction of its follicles; in other cases, in addition to increased vascularity, the mucous coat is softened and thickened; and in others still, especially if the inflammatory action have been protracted, ulceration occurs, for the most part, in the site of the solitary glands. Exceptionally, in fatal cases of measles attended with diarrhœa, no vascularity is observed after death, although the intestine may be thickened and softened. In such cases the diarrhœa was probably inflammatory, the injection of the vessels having disappeared after death.

Severe and obstinate diarrhœal affections occurring with measles, usually commence as the primary disease is about declining. They then become sequelæ, ending fatally in many instances, especially in the summer months, several days or perhaps weeks after the disappearance of the eruption. Diarrhœal attacks, occurring in, or previously to, the eruptive stage, are, as a rule, mild and easily relieved.

In some grave cases, measles have a tendency from the first to affect the internal organs more than the surface. There can coexist bronchitis, pneumonia, and entero-colitis, with indistinctness of the eruption on the skin. Such complications render a fatal result highly probable.

Eclampsia is also an occasional very dangerous complication. It sometimes occurs very suddenly and unexpectedly. A child of five years in my practice, apparently progressing favorably with measles, was allowed to sit at dinner with the family, suddenly and without premonition, eclampsia occurred, the rash receded, and notwithstanding vigorous treatment death resulted in a few hours. Rapidly developed cerebral congestion seemed to be present. To prevent such a complication, the patient should remain quiet in bed during the eruptive stage.

Another very fatal complication and sequel is true croup, commencing when rubeola is beginning to decline; but it is less frequent than pneumonia or entero-colitis. In catarrhal or false croup, which, as has been previously stated, is not infrequent at the commencement of measles,

the cough has a loud, ringing character. In true croup, on the other hand, it is hoarse or harsh, and less distinct, on account of the presence of the pseudo-membrane in the larynx. True croup, always a grave disease, is more serious when it occurs as a complication of measles than in the idiopathic form, not only because the blood is vitiated and the system reduced by the primary affection, but because the inflammation of the mucous surface is in general more extensive, as is also, I believe, the pseudo-membrane. This membrane in the croup of measles I have seen extend so far down the air-passages, that tracheotomy could not have been attended by any decided amelioration of symptoms. This complication, though always grave, is not, however, necessarily fatal. I have known cases recover by inhalation of spray, when for days there had been dyspnœa and other evidences of a pretty firm pseudo-membrane. True croup causes continuation of the fever, which had perhaps begun to abate.

Diphtheria, when epidemic, also frequently complicates measles. Much of the mortality from measles in this city, since the year 1858, was due to this cause. In cases observed by myself, diphtheria usually began while the fauces were still inflamed, and sometimes before the eruption had begun to fade. The pseudo-membranous laryngitis or true croup mentioned above, is, in most instances, in localities where diphtheria prevails, a local manifestation of this disease.

These are the most common complications of measles. There are others of less frequent occurrence, among which may be mentioned stomatitis, pharyngitis, and otitis sufficiently severe to be considered complications. Rarely, also, purpura, attended by hemorrhages from the different mucous surfaces, occurs in connection with measles. This complication is, however, more frequent in certain other constitutional diseases, as scarlet fever, and especially variola.

It is seen that the inflammations which are apt to occur in the course of measles are chiefly of the mucous surfaces. In scarlet fever, on the other hand, the inflammations are more frequently of serous surfaces.

There are other affections, originating in measles, which are rather sequelæ than complications. Gangrene of the mouth is one which, as stated in another part of this book, is more apt to occur after measles than any other disease. After a severe epidemic of measles in the New York Foundling Asylum, in 1874, three cases of gangrenous vulvitis occurred in those who had been affected. Ophthalmia commencing in measles often persists for weeks or months. It may give rise to granulation of the lids, and cases have been reported of violent inflammation of a purulent character, producing ulceration of the cornea, and destroying vision. The ophthalmia is sometimes very intractable. Inflammation of the Schneiderian membrane, commonly present during measles, often continues as a sequel, extending back as far as the Eustachian tube, where it may cause swelling, with impairment of hearing, and forward to the lip, where it may produce chronic eczema.

Anatomical Characters.—I have made, or witnessed, mainly in institutions, several post-mortem examinations of those who have died in, or immediately after, an attack of measles. In all there were lesions due to complications. Indeed, death directly from measles is so

rare that few have had an opportunity of studying the anatomical characters apart from the complications. In those who have died without any obvious coexisting disease, and these cases chiefly occur in the malignant form, there has been congestion of the internal organs, especially marked in the lungs, and sometimes the tissues appeared softened. The blood, also, in the malignant form, has a darker hue than natural, and ecchymotic patches have been observed upon the mucous surfaces and elsewhere, corresponding in character with the petechiæ under the skin which sometimes occur in this form of measles. In cases resulting fatally from bronchitis or pneumonia, the bronchial glands are commonly tumefied in the same manner as the mesenteric glands are enlarged in enteritis, and the glands of the mesocolon in dysentery.

Nature.—Rubeola, like the other exanthematic fevers, is due to a materies morbi, probably micrococci, as has been stated above. It is highly contagious through the air. It has been inoculated by the serum from vesicles which sometimes occur in connection with the rubeolous eruption, and also by the blood from a patient. Inoculation does not appear to moderate the disease, and as measles, when contracted in the ordinary way, is not in itself dangerous, but dangerous only from complications, inoculation is not performed, except as a matter of scientific interest. The usual mode of propagation is through the air. It is communicated both by the breath and clothing. By fomites the virus is sometimes conveyed a long distance. Under whatever circumstances measles may occur, probably the specific principle has been communicated from some infected person. We frequently meet cases, as one in a sparsely settled district that has come to my knowledge in which exposure cannot be traced. Yet the immunity of certain islands for centuries, till infected through commerce, renders the doctrine of an origin *de novo* improbable.

Twelve to fourteen days elapse from the time of infection to the commencement of the eruption. In cases observed in the children's department of Charity Hospital, the incubative period was ascertained to be about twelve days. In those who have been inoculated, this period is said to have been about one week. Rubeola prevails epidemically, like the whole class of infectious diseases, and in different epidemics the type may vary as well as the character of the complications.

Diagnosis.—The diagnosis of measles, previously to the eruption, is often difficult. The catarrhal symptoms then predominate, and these are such as may occur independently of any constitutional or blood disease. The first stage, therefore, is not infrequently mistaken for coryza, or mild bronchitis. The points of differential diagnosis are the suffused appearance of the eyes, the greater degree of fever on the first day than would be likely to arise from so moderate an amount of local disease, and morning remission and evening exacerbation of the fever. Measles in the first stage has been mistaken for remittent fever. The catarrhal symptoms should prevent such an error.

Sometimes roseola closely resembles measles in appearance, but the rash of roseola appears within a few hours after the commencement of febrile symptoms, and almost simultaneously over the whole body, and without

those local symptoms referable to the mucous surfaces, which characterize measles.

Variola on the first day of the eruption has sometimes been diagnosticated measles. I recollect once being called to an infant with fatal confluent smallpox, who was said to have measles. A physician, a few days previously, observing the red points in the commencement of the eruption, had made this absurd diagnosis, and, predicting a favorable result, had not thought it necessary to repeat his visit. In case of doubt, it is the part of prudence to defer making a positive diagnosis. A few hours suffice to show the distinctive characters of rubeolous and variolous eruptions. But the anxiety of friends often necessitates the expression of opinion. The absence or lightness of catarrhal symptoms, the earlier appearance of the eruption, and its papular feel under the finger in smallpox, enable us to discriminate between the two diseases in the commencement of the eruptive stage. Moreover, the symptoms in the initial periods are different, as will be seen in our description of smallpox.

Prognosis.—This is favorable, provided that no serious complication arises. With internal inflammatory complication, on the other hand, the disease becomes much more grave. A large proportion thus affected die. The prognosis is less favorable in feeble children with scanty eruption, or an eruption appearing at a late period and irregularly. Dyspnœa, persistent and great acceleration of pulse, and coma, indicate an unfavorable ending. Convulsions occur much more rarely in the course of measles than in scarlet fever, and when they occur after the initial period they usually end in coma and death.

Treatment.—Uncomplicated rubeola requires little medicinal treatment except to palliate symptoms. The child should be kept in an airy apartment, at a uniform temperature of about 70°. A temperature so elevated as to be uncomfortable to the nurse is injurious to the patient. But while the popular idea is erroneous, that he should be kept in a heated atmosphere, it is correct that currents of air and sudden reduction of temperature are dangerous. A violent and fatal attack of croup occurred in my practice in a girl of fifteen, in consequence of exposure at an open window at the close of the eruptive stage. The diet should be mild, and for the most part liquid. The patient, indeed, refuses solid food, but, on account of the thirst, takes liquids more readily. Farinaceous substances, with milk, afford sufficient nutriment in ordinary cases. If the previous health have been poor and the vital powers reduced, or if there be a complication, more sustaining diet is required. Stimulation by wine or brandy is needed in these cases. During the two or three weeks succeeding an attack of measles, care should be taken to avoid exposure to cold, or changes of temperature, since during this period there is great liability to inflammations of the mucous surfaces.

The cough ordinarily requires treatment, inasmuch as the suffering of the child and loss of sleep are largely due to this symptom. Demulcent drinks, as flaxseed tea, infusion of slippery-elmbark, or solution of gum Arabic, are useful, to which, to render them more palatable, lemon-juice may be added. A small Dover's powder, or the mistura glycyrrhizæ composita of the pharmacopœia, given occasionally, relieves the severity and diminishes the frequency of the cough.

As the chief danger in measles is from inflammation of the respiratory organs, local treatment directed to the chest is important. The chest should be covered with oil silk, unless in the mildest cases. This increases the amount of eruption upon the surface underneath, and, I believe, tends greatly to prevent complication by bronchitis and pneumonia. If the eruption be tardy in its appearance, or indistinct, it is well to produce moderate counter-irritation by some gentle irritant underneath, as camphorated oil, to which one-fourth part of turpentine is added.

Affections which complicate measles should receive, for the most part, such treatment as is appropriate for them when idiopathic. Secondary diseases, however, require sustaining measures more than primary. In bronchial and pulmonary inflammations, which, if they occur early in measles, prevent the regular appearance of the eruption, or, if in the eruptive stage, cause its disappearance, prompt counter-irritation over the chest by sinapisms or otherwise is required. Trousseau states that he has derived benefit, in these cases, from what he designates urtication. This is produced by stroking the chest two or three times daily with the nettle (urtica dioica or urtica urens). This causes a prompt and abundant eruption, and with a less amount of suffering than one would suppose. The fever abates, and the respiration becomes more natural in proportion to the amount of nettlerash. On the second day the effect is less than on the first, and after three or four days, says Trousseau, no further irritation results from the nettle. When counter-irritation is produced, by whatever method, the chest should be covered with a warm and soft poultice, as the ground flaxseed; derivatives to the extremities are useful in such cases. In capillary bronchitis and pneumonia stimulating expectorants are required, as carbonate of ammonium. The following I employ for a child of two or three years.

℞.—Tinct. ipecac. comp. (Squibb's liq. Dover's pulv.) gtt. viij–xvj.
Ammon. carbonat. . . . . gr. xvj–ʒss.
Syr. bal. tolut.
Aquæ . . . . . āā ʒj.—Misce.

Dose.—One teaspoonful every two or three hours.

Muriate of ammonium is also a good remedy in these cases, employed in double the dose of the carbonate.

Quinia to reduce the fever, and digitalis as a heart tonic, are also very useful in these inflammations, given alone or alternately with the above.

The cases of gangrenous vulvitis alluded to above were treated with a flaxseed poultice, and iodoform dusted over the surface each day or second day, with a satisfactory result. As regards the treatment of other complications, the appropriate measures are detailed elsewhere.

CHAPTER II.

SCARLET FEVER.

It is supposed by some who have studied the history of scarlet fever, that it is a disease of ancient origin, but the descriptions of diseases left us by the old writers, and by those in the Christian era until after the middle ages, are so obscure, or differ so widely in the statements made from the symptoms of scarlet fever, that the impartial critic fails to find any clear evidence of its occurrence prior to the last four or five centuries.

The first clear and undoubted portrayal of this disease in found in the medical literature of the sixteenth century. Sydenham and his contemporaries in the seventeenth century witnessed epidemics of it, studied its nature more thoroughly, and consequently acquired a more accurate knowledge of it than that possessed by their predecessors. It was in this century that measles and scarlet fever were differentiated. During the last two hundred years scarlatina has been the subject of monographs too numerous to mention. It has long been regarded as one of the most important maladies of childhood, on account of its frequency and the great mortality that attends it, so that numerous cases and many epidemics are every year related in the medical journals. By this vast accumulation of observations and the patient and thorough use of the microscope our knowledge of scarlet fever has become full and accurate.

As with most of the infectious maladies, scarlet fever extended to the Western World through European shipping. It was brought to North America about the year 1735. Tardily it spread to South America, where it appeared in 1829, and more recently it has been established in Australia. It entered Iceland in 1827, and Greenland in 1847.

Etiology.—The evidence is strong that scarlet fever does not originate *de novo*—that it does not spring from certain atmospheric or telluric conditions, but is produced by a definite specific principle, since countries have been free from it for centuries till it was imported by commerce. That it appears in certain localities without any known exposure is attributed to the fact that the poison is so subtle and transmissible that it is conveyed long distances in articles of merchandise, even in small packages, so that those who chance to open them or come in contact with them are infected. It is believed that reading matter transmitted through the mails has in many instances been the medium of infection.

The theory that the acute infectious maladies are caused by micro-organisms, or, as they are now designated, microbes, commonly discarded at first and believed to be chimerical, is rapidly gaining ground in the profession, and appears to be fully established as regards certain of them. These parasites, barely visible under high powers of the microscope, and ascertained to be vegetable by their behavior under certain chemical agents, exist in immense numbers in the blood, tissues,

and secretions of patients suffering from the infectious maladies, especially in the graver cases of them; and the microscope shows that these organisms vary in shape and appearance so as to admit of classification.

The germ theory has now become so important that it cannot be ignored in a monograph relating to so important an infectious malady as scarlet fever. The relation of microbes to the infectious diseases has been made the subject of investigation by Pasteur, Toussaint, and others in France, and by many in Germany, with most interesting results. The belief held by many, and which seemed very plausible, was that the microbes, instead of sustaining a causative relation to the maladies in which they occur, were the result of these maladies—that they sprang into existence in consequence of the vitiated state of the blood and tissues, just as fungi appear on decaying substances or as the oidium albicans appears in certain morbid condition of the buccal surface and secretions. Obviously, in order to elucidate this matter and determine the relation of these parasites to the diseases in which they occur, it was necessary to experiment on animals, but, unfortunately, as a bar to successful experimentation many of the most important infectious maladies which afflict the human race, as typhus and typhoid fevers, the marsh fevers, and syphilis, do not occur in animals, or they occur in a changed and mitigated form. Others, however, can be produced in their typical character in animals, as diphtheria, and others still originate in animals and are transmitted from them to man, as anthrax or splenic fever of the herbivora, and hydrophobia. Very interesting and important results have been produced by experimental researches with the microbes of certain of these diseases, which, if applicable to the common and fatal infectious maladies of an analogous nature in man, may yet result in immense benefit in mitigating the virulence of those affections which are the scourge of childhood, and which sensibly diminish the increase of population. It has been found possible to cultivate the microbes contained in the blood, tissues, and secretions in certain of the infectious diseases, and after a series of cultivations, so that these organisms are far removed from the animal substance which contained them, and with which they were so intimately associated in the individual, they have been employed for inoculation—with this important result, that the primary disease was reproduced. This seems to indicate beyond question the causative relation of these parasites to the diseases in which they occur. Experiments with the result which I have stated have been made with the microbes of splenic fever, chicken cholera, murrain, and certain other maladies.

Pasteur employs as the media for cultivation—(1) urine neutralized by a few drops of potash solution; (2) a liquid prepared by boiling for twenty or thirty minutes the yeast of beer in water, neutralizing and filtering; and (3), chicken tea, prepared by boiling equal parts of water and the lean of muscles a quarter of an hour, filtering and neutralizing. A small drop of infected blood is placed in the liquid of cultivation, and the microbes which it contains multiply so abundantly that the liquid becomes turbid in a short time, and they are found in all parts of it. A drop of this liquid is added to another portion of the medium, and

this also soon becomes turbid from the immense development of organisms which have the same microscopic appearance and character as those in the drop of blood. The process is repeated many times, until the microbes are far removed from their original source in the blood and tissues, and a drop of the last cultivation, whether it be the fiftieth or the hundredth, is inserted under the skin of a healthy animal selected for the experiment. If it be true, as stated by the experimenters, that the original disease is thus reproduced with the microbes of at least three or four distinct maladies, this age is distinguished by one of the most important discoveries ever made in pathological studies. It remains to determine whether this great discovery is of general applicability to the infectious diseases with which man is afflicted. If so, it is not improbable that we are on the eve of finding a method by which some at least of these maladies may be prevented or mitigated, as smallpox has been since the time of Jenner. The result of experiments made by Pasteur with the microbes of that fatal malady of the herbivora, known under the various names of splenic fever, anthrax, wool-sorter's disease, and charbon, encourages this belief. Originating among the herbivorous animals, it has in many instances been contracted by individuals who have rapidly perished. Many engaged in assorting alpaca and mohair have lost their lives by it, some with all the symptoms of profound blood-poisoning, without external lesions, and others with redness and swelling at some point of infection where a sore or abrasion existed, but with speedy blood-contamination.

The microbe of this malady, the bacillus anthracis, occurs in the form of straight filaments with little movement or only with oscillation, and producing bright-shining spores. Now comes a very interesting and important result of experimentation: Pasteur states that if several days elapse between the cultivations the virulence of the parasite diminishes, so that he has been able to produce by inoculation with it a mild and never fatal form of charbon, which affords immunity in the animal from any subsequent attack. This opinion was sustained by a trial experiment on sixty sheep. Toussaint and Chaveau claim that they produce a similar attenuation of the virus by defibrinating infected blood, heating it to 55° C. (131° F.), and filtering it. These experiments awaken the hope that the time will come when the acute infectious maladies in man, scarlet fever among others, will be rendered less virulent. That one of them, to wit, smallpox, has for nearly a century been under our control certainly encourages the belief that there is some way to mitigate others of the same class which are equally fatal if not so loathsome.

As yet, observers do not agree in regard to the parasite which is supposed to sustain a causative relation to scarlet fever. Klebs states that it is highly probable that both measles and scarlet fever are produced by micrococci, and he has sketched the design and described the development of a microbe which he designates the Monas scarlatinosum.

The *London Medical Times and Gazette* for Jan. 28, 1882, contains an account of the supposed discovery of the scarlatinous microbe by Eklund, of Stockholm, an authority in the microscopic examination of parasites. He says that scarlet fever is rarely absent from the Swedish capital and from the barracks and dwellings on the isle of Skeppsholm.

In the urine of scarlatinous patients he has constantly found a prodigious number of discoid corpuscles, oval or round, their diameter being less than $\frac{1}{1000}$ millimetre, and from $\frac{1}{30}$ to $\frac{1}{10}$ that of a red blood-cell. They are colorless or yellowish-white, surrounded by a distinct cell-wall, each containing a well-defined nucleus of a deeper hue. Sometimes one sometimes more of them are seen in the field of the microscope. They exhibit rotatory or oscillatory movements, especially observed when a drop of water is added to the fluid. They multiply, as Eklund has frequently seen, by fission—first in the microbes, next in the nucleus, and lastly in the cell-wall. He cannot say whether they develop into a mycelium. At any rate, the development of fine filaments seems to be exceptional. He has never seen them adhere in moniliform chains nor massed as zoöglæa. He considers them to be veritable schizomycetes, and proposes the name Plox scindens.

Eklund asserts that he has found these organisms in vast numbers in the soil- and ground-water of the isle of Skeppsholm, in the mud of the trenches dug for the water-mains, and in the greenish mould upon the walls of the old barracks, where scarlet fever was most rife. He states that scarlet fever has occurred in children after drinking milk mixed with the ground-water of the island, and he observed a case which followed immersion in one of the trenches of the island and the drying of the clothes in a small room. In another instance, scarlet fever broke out in a block immediately after exposure of the ground-water by excavations.

It is evident that the discovery of this microbe under such circumstances does not prove that it is the cause of the disease. This can only be determined by inoculation, or by experiments which furnish the conditions of scientific exactness. Although great progress has been made in parasitology during the last decade, it is evident that several years of observation and experimentation must elapse before it is clearly and definitely ascertained whether, or to what extent, microbes cause scarlet fever and the other exanthematic fevers with which it is classified.

Whether the specific principle of scarlet fever be a microörganism or a chemical substance, its mode of action and effects have been ascertained by clinical observations. Without doubt it commonly enters the system by the breath, but it may enter in the ingesta, and it infects the blood. That it resides in the blood, has been ascertained by inoculation with this liquid, by which scarlet fever has been reproduced in its typical form. From the blood it enters the tissues and secretions. Hence handkerchiefs or linen containing the saliva or mucus of a patient, the epidermic scales shed abundantly in the desquamative period, and probably also the urinary and fecal evacuations, contain the poison, so as to be highly infectious. Even the discharge of a scarlatinous otorrhœa is thought by some to be contagious for a considerable time.

Scarlatina is communicable not only by direct exposure to a patient, but also by exposure to objects which happen to be in his room during his illness, and to which the poison becomes attached, such as clothing, books, and toys; small packages, as we have stated above, sometimes convey and disseminate the contagious principle.

In England observations have been made which show that scarlatina

has been communicated by infected milk. The disease occurred in the family of a milkman, and the milk, before it was distributed, remained for a time in a kitchen which had been occupied by the patients. This milk was taken by twelve families, and in six of these the disease occurred almost simultaneously at a time when few cases were occurring in the locality. There had been no direct exposure to the carrier of the milk nor to members of the affected family (Taylor). In another instance a woman and her son had scarlet fever while they were serving milk to several families, and the disease appeared in all these families except one, which consisted of old people (Bell). It is known that milk absorbs volatile substances so as to be flavored by them, as is shown in the experiment of placing it in an open vessel in a box with a pineapple; and it may in a similar manner become infected by the specific principle of scarlet fever, or it may be infected by detached particles of epidermis; which is not improbable when one convalescing from scarlet fever is allowed to milk the cows or prepare the milk for distribution.

The scarlatinous virus surpasses that of any other eruptive fever except smallpox in its tenacious attachment to objects and its portability to distant localities. Hence in the literature of the disease are the records of many cases in which the poison was conveyed long distances, retaining its virulence to the full extent and causing an outbreak of the malady in the localities to which it was carried. In New York, so frequently has scarlet fever as well as measles and diphtheria been contracted from the persons or clothing of well children who come from infected houses, that the Health Board now exclude from the public schools all children who come from such houses, even though they live on separate floors from those occupied by the sick. In one instance that came under my notice a washerwomen whose child had scarlet fever communicated the disease to an infant in the household where she was employed, by placing her shawl over the cradle in which it was lying. A physician of my acquaintance went from a scarlet-fever patient to a family several streets distant, and took one of their children upon his lap. After the usual incubative period this child sickened with a fatal form of the malady, and the remaining children of the household were in time affected. In New York, scarlet fever has seemed to me to be not infrequently communicated through school books, which, profusely illustrated by pictures and rendered attractive to the young, are often allowed to lie upon the bed of a scarlatinous patient and be handled by him during convalescence, or even during the course of the fever if it be mild. The young librarian of the circulating library of a Sunday-school, whose pupils came largely from the tenement houses, was occupied a considerable part of a day in covering and arranging the books. After about the usual incubative period of scarlet fever he sickened with the disease. His two sisters were immediately removed to a rural township three hundred miles away, and to an isolated house where scarlatina had never occurred. About one month after his recovery, and after his room had been disinfected by burning sulphur and his bedclothes and linen had been thoroughly washed, and all articles suspected to hold the poison had been either

disinfected or destroyed, the brother visited his sisters in the country. Three weeks subsequently to his arrival one of these sisters sickened with scarlet fever, and a week later the other also. It seems that the exposure must have occurred several days after his arrival in the country from some book or other infected article in his possession. About two months elapsed after the last case; the family had returned to the city, the infected room in the country-house had been thoroughly fumigated by burning sulphur from morning till evening, when a little girl from an inland city remained a few days in this house, and probably often entered the room where the young ladies had been sick. In a few days she also sickened with a fatal form of scarlatina. Such histories and experiences are not infrequent. They are common during epidemics of scarlet fever. They indicate an extraordinary attachment of the scarlatinous poison to objects, and show that it is not gaseous nor readily volatilized.

A striking example of this fixity of the poison occurred in the practice of the late Kearney Rogers, formerly a prominent and much esteemed surgeon of New York City. Six children in a family had scarlet fever. Three and a half months subsequently another child, living at a distance, was allowed to return home and occupy the apartment in which the sickness had occurred. One week subsequently to the date of the return this child sickened with the same malady. Elliotson states that a patient with scarlet fever was admitted into one of the wards of St. Thomas's Hospital, and for two years subsequently young persons who were admitted into the ward were apt to take the disease. Richardson, of London, relates the following experiences of a family whom he attended in the rural district: "At a short distance from one of our villaegs there was situated on a slight eminence a small clump of laborers' cottages, with the thatch peering down on the beds of the sleepers. A man and his wife lived in one of these cottages with four lovely children. The poison of scarlet fever entered the poor man's door, and at once struck down one of the flock." The remaining children were now removed some miles away, and after several weeks one of them was allowed to return. With twenty-four hours it also took the disease, and quickly died. The walls of the cottage were now thoroughly cleaned and whitewashed, the floors scoured, and all the wearing apparel either destroyed or washed. Four months elapsed after the last sickness when one of the remaining children returned. "He reached his father's cottage early in the morning; he seemed dull the next day, and at midnight I was sent for, to find him also the subject of scarlet fever. The disease again assumed the malignant type, and this child died." Richardson believes that the contagion was attached to the thatch, which could not be thoroughly disinfected. The fact of this remarkable long-continued attachment of the poison to objects, indicating by this fixity that it is a solid, is consonant with the theory that it is an organism.

Incubative Period.—The duration of the incubative period varies in different cases. It is sometimes less than twenty-four hours, as in the above case reported by Richardson; in the following well-known case, observed by Trousseau, it was one day. A girl arrived in Paris

from Pau, where there was no scarlet fever, and occupied the same apartment with her sister, who was sick with this disease. Twenty-four hours after her arrival she also was attacked with the same malady.

Russeberger attended a child who was exposed at noon to scarlet fever, and took the disease on the following night. B. W. Richardson (*Clinical Essays*, 1861, vol. i. p. 94) gives his own experience. He had applied his ear to the chest of a patient suffering from scarlet fever, and was conscious of a peculiar odor emitted from the patient. He was immediately nauseated and chilly, and from that moment he dated the beginning of an attack of scarlet fever. In the *Transactions* of the Clinical Society of London, vol. ix., 1878, the late Charles Murchison gives the statistics of 75 cases, showing the incubative period, as follows:

In	4 cases it was not more than	24 hours.
"	2 " " " "	30 "
"	3 " " " "	36 "
"	4 " " " "	40 "
"	1 " " " "	41 "
"	4 " " " "	58 "
"	1 " " " "	54 "
"	1 " " " "	2½ days.
"	31 cases it was within (time not accurately ascertained)	4 "
"	2 cases the incubation did not exceed	4½ "
"	17 " " " "	5 "
"	2 " " " "	6 "

In three cases Murchison believes that the incubation was precisely fixed at thirty-six hours, three days, and four and a half days.

Watson says that a man reached Devonshire on mid-day to see his daughter, who had scarlet fever. Two days later he was also attacked. Rehn saw a child who was attacked two days after its grandmother returned from a case of scarlet fever; and Zengerle, a girl of ten years, residing at Wangen, where there was no scarlet fever, who took the disease two days after her mother had returned from visiting a family affected with it. Loochner states that a boy aged four and a half years was attacked one and a half days after admission into the infected wards of a hospital. Armistead, in his annual report on the health of the Newmarket rural district, states that three children, coming from a different part of the district, visited Westley, and stayed next door to a child who had scarlet fever six weeks previously, and who was allowed to play with these children on the evening of August 13th and morning of the 14th. The family then returned home, and on the 18th, four days after the exposure, all three children sickened with scarlet fever (*British Medical Journal*, September 30, 1882).

Ordinarily, therefore, the incubative period, though varying in different cases, is within six days. Many cases, however, occur in which it seems to be longer. Thus, in my practice, scarlet fever appeared in a family on April 26, 1882. The patient was immediately removed to the third floor and the other children to the basement. All communication between the infected room and the basement was forbidden, but on May 8th, twelve days after the separation, one of these children sickened with the disease. Many observers, among whom may be mentioned Niemeyer and Copland, believe that the incubative period

may be longer than one week, but, on account of the subtlety of the poison and the many modes of transmission, it is possible that in the instances of an apparently long incubative period there were other and unsuspected exposures. When scarlet fever has been communicated by inoculation, as in the experiments of Rostan and others, the incubative period has been about seven days, but Gerhardt states that a man was attacked four days after an abscess was opened by a knife used upon a scarlatinous patient. This variation in the incubative period, which also occurs in some other infectious diseases, as diphtheria, is probably due mostly to individual differences, some being more susceptible than others; but it may be due partly to those obscure meteorological conditions which we designate the epidemic influence. Probably, as a rule, when the disease is quickly developed after exposure, the attack is more severe than when several days elapse.

Contagiousness.—The area of the contagiousness of scarlet fever is small. It apparently embraces only a few feet. Therefore, close proximity is the necessary condition of its propagation. Hence many who are exposed, particularly of those who are remotely exposed, do not contract the disease. There is also an idiosyncrasy in some children, so that they resist infection even when repeatedly and closely exposed. In the *New York Medical Record* for March 23, 1878, C. E. Billington states that of 90 children in 26 families who were exposed to scarlet fever, 43 contracted the disease and 47 escaped; whereas, as is well known, comparatively few unprotected children escape pertussis, variola, varicella, or measles if exposed to either of these diseases. By strict isolation, therefore, the spread of scarlet fever is more easily prevented than that of most other acute infectious maladies. In the New York Foundling Asylum for a number of years children with scarlet fever were isolated in a small room attached to one of the wards. The door between the two rooms was closed, and not opened during the continuance of the sickness. Entrance into the small room was through another door, and a nurse was assigned to the scarlet-fever cases, with strict directions that she should not mingle with the other children. These simple precautions were found sufficient in the various epidemics of scarlet fever which occurred in the city to prevent the spread of the malady through this institution; whereas, similar measures were much less effectual in arresting the spread of measles and pertussis. Consequently, an outbreak of scarlet fever in this institution was usually limited to a few cases, while the extension of measles and pertussis was arrested with difficulty till a more efficient quarantine was established.

Variations in Type.—The type of scarlet fever varies greatly in different epidemics, and frequently also in cases which occur in the same epidemic, even in the same family. One child may have scarlatina so mildly that little treatment is required and convalescence soon begins, while another has the malignant form, and soon succumbs, notwithstanding the prompt employment of the most efficient and appropriate measures. Ordinarily, however, if the first case in a family be very severe, subsequent cases will present a similar type; but there are notable exceptions. This variation in type in different years and different epidemics is probably not equalled in any other infectious

malady. Consecutive epidemics may present this variation, or the same type may continue for a series of years, and then, from some unknown cause, change to one milder or more severe. In England, during Sydenham's life, scarlet fever was so mild that he regarded it as a trivial affection, requiring little attention, like rötheln of the present time, but after the death of Sydenham, Morton and his contemporaries in London found, to their sorrow, that the type of scarlet fever was very different from that described by Sydenham's pen. The late Dr. Graves, of Dublin, and his contemporaries treated a mild type of scarlet fever with a very small percentage of deaths—much less than that during the preceding generation—and they attributed their success to their greater knowledge and more appropriate use of remedies than their ancestors possessed and employed. By and by the type changed, the mortality of former years was restored, and they discovered that their previous success in saving life had been due not to their skill, but to the mild form of the malady. A distinguished physician of New York treated more than fifty cases of scarlet fever in one of the institutions without a single death. A few months afterward the type of the malady changed, and his own son perished from it.

Surgical and Obstetrical Scarlatina.—After surgical operations, and sometimes in surgical cases not requiring operative measures, a scarlatinous efflorescence occasionally appears upon the whole or nearly the whole body, and remains for several days. The following were cases of the kind alluded to. They occurred in Guy's Hospital, and were published by H. G. Howse in *Guy's Hospital Reports* for 1879: On March 15, 1878, Jacobson performed osteotomy upon a child suffering from extreme rachitis. The operation was followed by a moderate febrile movement (100° to 101°), and after three days by the appearance of an efflorescence, with sore throat and the strawberry tongue. The osteotomy had been performed under carbolic acid spray and with all the details of antiseptic surgery. The rash soon faded, the temperature fell, and the child, temporarily separated from the other patients from the suspicion that the disease was scarlet fever, was brought back to the ward. The subsequent history confirmed the diagnosis of scarlet fever, for the skin desquamated, and on April 1st abundant albumen was found in the urine. The case terminated favorably. Three months previously the same operation had been performed on the other leg, with no unfavorable symptoms. On April 5th, three weeks after the osteotomy, a lipoma was removed from another patient aged twenty-one years. The following day the temperature rose to 101°, and remained at that till April 8th, when it suddenly increased to 103°, and a rose-rash occurred over the body, with sore throat. On April 9th, Howse excised the elbow-joint of a girl of sixteen years having pulpy disease. On the 10th her temperature began to increase, and on the 11th reached 105.8°. Toward evening a roseoloid eruption appeared over her body, and she was isolated. On April 12th, Dr. H. excised a fibroid bursa patellæ from a woman of twenty-nine years. On the following day her temperature was 99°, but on the 14th it rose to 100°, and on the evening of the 15th she had rigors and headache. On the morning of the 16th the temperature was 102.5°, and a roseo-

loid eruption occurred over the face and chest. The surgeons now perceived that an epidemic of the so-called surgical scarlatina was occurring, so as to justify the postponement of other operations.

In the same volume of *Guy's Hospital Reports*, James F. Goodhart gives the histories of nearly thirty cases of this disease occurring during a series of years in the same hospital. The patients were chiefly children, having the most diverse surgical ailments, among which may be mentioned hip disease and abscess, genu valgum without operation, necrosis of femur, hydrocele with explorative operation, a scald, a sinus over the great trochanter, spinal disease with abscess, tenotomy for club-foot, and vesical calculus with operation. The most common disease was caries or necrosis with abscess. In cases operated on the intervals between the operations and the occurrence of the efflorescence varied from two days to more than two weeks. Goodhart, after a careful examination of these cases, came to the conclusion that they were for the most part examples of true scarlet fever, especially as a considerable proportion of them occurred in groups, and there was a known exposure of some of the patients to children admitted into the hospital with the sequelæ of scarlet fever.

In the *British Med. Journ.* for Jan. 1879, George May, Jr., reported a case of efflorescence in surgical practice which appears to have been scarlatinous. A child was operated on for the radical cure of hernia on Dec. 4th. Toward the close of the same day he became restless, vomited, and his pulse on the following day rose to 136. Forty-eight hours after the operation a rash appeared on the chest and arms, the abdomen became tense and painful, and on the following day he died. The poison, however, in this case may have been septic.

Hillier remarks (*Diseases of Children*): "In the hospital for sick children, of the children who contract scarlatina a very large proportion have been the subjects of a surgical operation within a week before the rash appears." Gee says (Reynolds's *System of Medicine*): "It has been doubted by some whether the scarlatiniform rash which sometimes follows operations is really scarlatinal. The eruption appears from the second to the sixth day after the operation, and in the cases which have caused the doubt is very fugitive and the first and only symptom. Yet that the disease really is scarlet fever would seem to be proved by the following observations: first, that the disease occurs in epidemics; secondly, that in a given epidemic a severe case occasionally relieves the monotonous recurrence of the very mild form; thirdly, that a precisely similar scarlatinilla attacks in the same epidemic patients who have not been subjected to operation and who have no open sore; and lastly, by way of a veritable experimentum crucis, that, however freely these patients are exposed to ordinary scarlet fever contagion, afterward, they do not contract that disease." Paget and other distinguished London surgeons who have observed this complication of surgical cases, believe that the patients have been previously exposed to the scarlatinous poison, and that the surgical diseases or operations furnish favorable conditions for the occurrence of scarlet fever, so that the exposure, which probably would have been without result in ordinary health, causes an outbreak of the malady.

Those who have reported cases of this form of efflorescence have for the most part neglected to state whether the patients had had scarlet fever previously, knowledge of which would have aided in the diagnosis; but from an examination of the histories of cases, especially those published in the London journals in the last four or five years, there can, I think, be little doubt that surgical maladies of a certain kind, especially traumatism, do produce a state of system which predisposes to scarlet fever, so that this class of patients are especially liable to contract it. Therefore, in my opinion, a considerable proportion of reported cases of surgical scarlatina are genuine, but in a considerable number, perhaps an equal number of such cases, the histories and symptoms indicated a septic rather than scarlatinous efflorescence, and in not a few instances, when consultations have been held, opinions differed, some diagnosticating scarlet fever, others septicæmia. In some of the cases I find it stated that the fauces presented the normal appearance. Now, faucial redness is so generally present in scarlet fever, antedating that of the skin and coexisting with it, that its absence is strong evidence that the disease is not scarlatinous. Moreover, when, as was true of certain of the reported cases, the rash appeared irregularly upon the surface, and faded away in two or three days with the abatement of the fever, and the conditions for septic absorption were present, the efflorescence was probably septicæmia.

The following were apparently cases of septicæmic efflorescence: A child aged five years, (*Brit. Med. Journ.*, Feb. 15, 1879) had inflammation of the lymphatic glands in the groin, which suppurated. At the time when the abscess was fully formed a rash appeared over the entire body. It consisted of numerous red points, but was paler than that of ordinary scarlet fever; temperature never above 99°; no sore throat nor desquamation of cuticle No child exposed to her took scarlet fever, and her sickness could not be traced to infection. In the *British Med. Journ.*, Jan. 4, 1879, L. Braxton Hicks states that his son, attending school at Reading, was seized with a severe attack of pyrexia, accompanied on the second day by delirium and the occurrence of a rash like scarlet fever over the entire surface. He had no decided redness of the fauces, though it was perhaps slightly flushed. The right buttock was swollen from inflammation, and a large, deep-seated abscess formed near the tuberosity of the ischium. When the delirium abated the boy said that he was standing the day before the fever began with his legs far apart, when a schoolfellow stretched them further by suddenly pulling on one of them. The rash, which was nearly universal, lasted three days, and was not followed by desquamation. No case of scarlet fever occurred in the school before or afterward. In the same volume of the *British Medical Journal*, Surgeon Frolliott, of the East India Service, relates the case of a private, aged twenty-three years, and three years in India, who, when on duty in the Punjab, was injured by the explosion of an Afghan powder-magazine. The accident occurred Dec. 21, 1878. On Dec. 25th a bright scarlet rash appeared upon the abdomen and spread over the entire body. The following day the eruption was very vivid, like a boiled lobster, and it lasted five days. The temperature, which in the beginning had been 101°, abated to the normal after the rash appeared. No soreness of

throat nor redness of the buccal surface occurred, but the epidermis desquamated even from the palms of the hands and soles of the feet. Now, the febrile movement of scarlet fever does not cease while the efflorescence is distinct. It does not even diminish when the eruption appears, while in the above case it fell to the normal—a common occurrence in septicæmia, even when the blood-poisoning is profound. Moreover, scarlet fever is so rare in India that Frolliott, after twelve years' service, had only heard of one case among Europeans and natives. The surgeons who consulted over the case of this private disagreed in opinion, some regarding the disease as septicæmic, others as scarlatinous. But a better knowledge of the clinical history of scarlet fever on the part of these army surgeons would, I think, have removed all doubt as to the diagnosis.

It is the opinion of some reputable surgeons that the exposure of traumatic patients to the scarlatinous poison sometimes aggravates the inflammation of wounds, causing them to assume an unhealthy appearance even though no scarlatina be produced. The late Dr. Solly made the remark, "Whenever a case of surgery in private practice takes on a highly phlegmonous appearance I am always sure to find break out, in the inmates of the house, either erysipelas or scarlet fever" (*British Med. Journ.*, Feb. 15, 1879). We will see that the scarlatinous poison sometimes causes pharyngitis or nephritis without producing the general disease. In a similar manner it seems that it may aggravate open wounds, intensifying the inflammation in them, while there is no efflorescence or other symptom to show that scarlatina itself is present. The poison appears to act entirely locally in such cases.

Paget, in his *Clinical Lectures*, says: "I think it not improbable that in some cases results occurring with obscure symptoms within two or three days after operations have been due to the scarlet-fever poison, hindered in some way from its usual progress." Playfair, in his remarks on the puerperal state, adds: "Mr. Spencer Wells informs me that he has seen cases of surgical pyæmia which he had reason to believe originated in the scarlatinal poison; and his well-known success as an ovariotomist is no doubt, in a great measure, to be attributed to his extreme care in seeing that no one likely to come in contact with his patients has been exposed to any such source of infection." Opinions like these, held by such prominent members of the profession and sustained by many observations, should certainly induce physicians to prevent, so far as possible, exposure of their surgical patients, especially if they have sores or wounds, whether by traumatism or scalpel, to the scarlatinal poison.

. Obstetrical Scarlatina.—Women during convalescence after childbirth are very liable to contract scarlet fever. In the New York Infant Asylum, which has maternity wards, a woman was admitted from a house in which scarlet fever was prevailing, and assigned to a cot next that occupied by one of the waiting women, who was confined soon afterward. Her labor was favorable, but three days afterward she took scarlet fever, and another lying-in patient contracted it from her. The sore throat and desquamation were characteristic. It has come to my knowledge that a physician of New York, in whose family scarlet fever

was occurring, attended three women in succession in their confinement, and all contracted scarlet fever, which presented the characteristic symptoms, and two of them died. Experienced and cautious physicians of New York, aware of the danger, do not go directly from a scarlatinous patient to an obstetrical case, but avoid the risk by intermediate visits to other patients or by remaining for a time in the open air.

Playfair, remarking on this subject, says: "There is good reason to believe that the contagium of zymotic diseases may produce a form of disease indistinguishable from ordinary puerperal septicæmia, and presenting none of the characteristic features of the specific complaint from which the contagium was derived. This is admitted to be a fact by the majority of our most eminent British obstetricians, although it does not seem to be allowed by Continental authorities, and it is strongly controverted by some writers in this country. It is certainly difficult to reconcile this with the theory of septicæmia, and we are not in a position to give a satisfactory explanation of it. I believe, however, that the evidence in favor of the possibility of puerperal septicæmia originating in this way is too strong to be assailable. The scarlatinal poison is that regarding which the greatest number of observations has been made. Numerous cases of this kind are to be found scattered through our obstetric literature, but the largest number are to be met with in a paper by Braxton Hicks. Out of 68 cases of puerperal disease seen in consultation, no less than 37 were distinctly traceable to the scarlatinal poison. Of these, 20 had the characteristic rash of the disease, but the remaining 17, although the history clearly proved exposure to the contagium of scarlet fever, showed none of its usual symptoms, and were not to be distinguished from ordinary typical cases of the so-called puerperal fever. On the theory that it is impossible for the specific contagious diseases to be modified by the puerperal state, we have to admit that one physician met with 17 cases of puerperal septicæmia in which, by a mere coincidence, the contagion of scarlet fever had been traced, and that the disease nevertheless originated from some other source—a hypothesis so improbable that its mere mention carries its own refutation."

Parturition, like traumatism, furnishes in an eminent degree the conditions in which septic poisoning occurs, and the efflorescence which often accompanies septicæmia bears, as we have seen, a very close resemblance to that of scarlet fever. Hence in many instances the same difficulty is present in making a differential diagnosis between septic and scarlatinous blood-poisoning in obstetrical cases which occurs in surgical practice. But, according to my observations, an efflorescence occurring during the week following parturition is in most instances septic. It is only in exceptional cases that it is scarlatinous, and there is little danger that the accoucheur, engaged in general practice and visiting scarlatinous patients, will communicate scarlet fever through his person or clothing if he exercise proper precautions. His short stay in the sick-room and his outdoor exercise in visiting cases prevent infection of his person or dress. But if, as Playfair believes, the scarlatinal poison sometimes produces in parturient women a puerperal fever in which the characteristic scarlatinal symptoms are lacking, and

which, in the present state of our knowledge, is not distinguishable from ordinary septic fever, certainly the scarlatinous virus sustains a much more frequent causative relation to childbed fever than has been heretofore supposed.

Infants under the age of six months do not ordinarily contract scarlet fever, although fully exposed, and those under four months nearly possess immunity. Still, this disease has been observed in new-born infants, contracted apparently, through the placental circulation. Tourtual states that a woman waited upon her own husband and child, both of whom had scarlet fever, during the eighth and ninth months of her pregnancy, till near her confinement. Though she had no symptoms of scarlet fever, her infant had unusual redness of the skin and buccal surface and difficulty of swallowing up to the fifth day. On the ninth day desquamation began, and at a later stage the nails of the fingers and toes separated. A case having a history in some respects similar is related by Megnert, but the symptoms were anomalous for scarlet fever, and the disease may have been ordinary septic fever. On the other hand, in one instance in my practice a mother had scarlet fever, beginning about the third day after her confinement, and although she suckled her infant and it was constantly in bed with her, it had no symptoms of scarlet fever, although it became affected immediately afterward by a severe form of eczema, probably from the altered quality of the milk; and in two instances observed by Murchison new-born infants remained healthy, although their mothers suffered from scarlet fever.

After the age of six months the liability to scarlet fever increases till the close of infancy, children between the ages of six months and one year being less liable to contract the malady than during the second year, and those in the second year being less liable to it than those in the third year. Murchison collected the statistics of deaths from scarlet fever in England and Wales during a series of years ending with 1861. The number of deaths aggregated 148,829, and the percentage of deaths at different ages was as follows:

Deaths under 1 year	. . . . .	6.7 per cent.
" between 1 and 2 years	. . . . .	14.09 "
" " 2 and 3 "	. . . . .	16.00 "
" " 3 and 4 "	. . . . .	15.13 "
" " 4 and 5 "	. . . . .	11 9 "
" " 5 and 10 "	. . . . .	25.9 "
" " 10 and 15 "	. . . . .	5.8 "
" " 15 and 25 "	. . . . .	2.6 "
" " 25 and 35 "	. . . . .	0.8 "
" over age of 35 "	. . . . .	0.8 "

Among the deaths were ten cases above the age of eighty-five years, so that scarlet fever, though especially a disease of childhood, may occur in any decade of life; but old age, like early infancy, almost possesses immunity from it.

I have preserved the records of the ages of 145 consecutive cases occurring in private practice. If we add to these 58 cases observed by Prof. Octerlony (*Amer. Jour. of Med. Sci.*, July, 1882) we have the statistics of the ages of 203 cases, which are embraced in the following table:

Under 1 year	3
From 1 to 2 years	25
" 2 to 3 "	43
" 3 to 5 "	57
" 5 to 10 "	53
" 10 to 15 "	13
" 15 to 20 "	3
" 20 to 30 "	4
" 30 to 40 "	2
Total.	203

CLINICAL FACTS REGARDING SCARLET FEVER.—As a rule, scarlet fever occurs but once, one attack conferring immunity from the disease for life; but there are exceptions. In 1869, I attended a child with fatal scarlet fever who three years previously, it was stated, had passed through a first attack with all the characteristic symptoms. The following case occurred in a family attended by the late Dr. Herzog: R——, a boy of six years, had scarlet fever in a mild form in January and February, 1875, followed by moderate desquamation. In July of the same year he was kicked by a horse in the street, receiving a deep scalp-wound which required three stitches. Three days afterward he had, to appearance, a second attack of scarlet fever, attended by high febrile movement, and followed also by desquamation. It was believed by Dr. H. to be a genuine case, and was so treated. I am not able to state as regards the presence of soreness of the throat, and doubt arises whether this second attack may not have been septicæmic. In April, 1876, a third attack occurred, which I saw from the beginning. It was accompanied by all the characteristic symptoms—injection of the fauces, an efflorescence continuing the usual time, followed by desquamation and albuminuria, the latter remaining several weeks. Richardson states that three distinct attacks occurred in his own person, and a student attending the lecture at which this was mentioned informed the doctor that he also had had scarlet fever three times.

Sometimes a second attack occurs so soon after the first that it has been described as a relapse. The following was a case in point in the practice of Godneff (*Meditz. Vestnik.*, No. iv., *N. Y. Med. Rec.*, April 30, 1881): A youth of seventeen years contracted scarlet fever while taking care of a child. It began with a chill, and he had the usual efflorescence, sore throat, and tumefaction of the cervical glands. An exudation appeared upon his tonsils and uvula, and his temperature reached 104°. The urine contained a trace of albumen, the rash in due time faded, and the epidermis exfoliated. On the fifteenth day, when he was about ready to leave the hospital, he again had a chill, followed by fever. The temperature reached 105.2°, the rash reappeared over the entire surface except the face, diphtheritic exudations occurred upon the fauces, and the urine, the quantity of which was diminished, again became albuminous. This second efflorescence faded on the twenty-fourth day, and on the twenty-seventh exfoliation began. Hillier says: "I have seen a young woman in the fever hospital suffering from a second attack of scarlatina, the first attack having occurred five weeks previously. She had quite recovered from her first illness, and was acting as nurse. In both seizures the rash, the sore throat, and other symp-

toms were characteristic. The relapse or recurrence was less severe than the primary disease." Cases of a fourth, or even of a greater number of attacks, have been reported. The first seizure is sometimes milder, but in other instances is more severe, than those which follow.

Exposure to the scarlatinous poison not infrequently produces pharyngitis without the occurrence of scarlatina, and the inflammation is usually severe, accompanied by pain in swallowing and marked febrile movement. This phlegmasia is distinguished from scarlet fever by its shorter duration and the absence of the efflorescence. It occurs in adults as well as in children, and in those who have had, as well as in those who have not had scarlatina. So far as I have observed, it is very seldom accompanied or followed by any of the complications or sequelæ so common in and after scarlet fever. It cannot be distinguished from ordinary pharyngitis except in the manner in which it occurs, and one attack does not preclude another. The late George B. Wood made the remark that he never attended a case of scarlet fever without suffering from sore throat. The following were examples of this form of pharyngitis: On Jan. 17, 1882, I was called to a boy of three years with severe scarlet fever, ushered in by convulsions. On the following day his sister, aged seven and three-fourths years, whom I had attended a year previously during a severe attack of scarlatina, and who had been almost constantly with the brother, became very ill, with a temperature of 103.5°. Examination revealed severe inflammation of the fauces, without pseudo-membrane or any other exudation except muco-pus. On Jan. 19th an older brother, nine years, whom I had attended in scarlet fever three years previously, was affected in the same way, his temperature being 104° and his respiration guttural and noisy, especially during sleep, in consequence of the great amount of faucial swelling. At times he was delirious. The inflammation in both cases began to abate about the third day, and had disappeared by the close of the week. That the contagium of scarlet fever may be received into the system and cause pharyngitis, while the patient has immunity from scarlet fever through a previous attack, and that this inflammation may occur any number of times, as in the case of Dr. Wood, are remarkable facts.

Now and then cases occur which appear to show that the scarlatinous poison may affect the kidneys, producing nephritis, while there is no other manifestation of its influence. Thus in my practice a lady of about forty-five years constantly attended her son, sleeping by his side, during an attack of scarlet fever. Her health had previously been good. When the boy was convalescent, as her appetite failed and she was indisposed, a careful examination revealed the fact that she had albuminuria, although she had had no sore throat or other symptoms of scarlet fever. After several weeks of treatment her disease was removed, and she has remained well since. In the *British Med. Jour.* for Nov. 29, 1879, it is stated that in a family four girls were found to be suffering from desquamative nephritis. One of them had recently had scarlet fever, but the other three had presented no symptoms whatever of this disease. Such cases, although probably rare, appear to show that, as the scarlatinous poison may produce inflammation of the fauces without the occurrence of scarlet fever, so it may cause nephritis without pro-

ducing the general disease, or apparently disturbing the functions, or changing the state of other parts, except the kidneys.

Symptoms.—*Ordinary Form.* Scarlet fever usually begins abruptly, so that the exact time of its commencement can be fixed. If any premonitory symptoms occur, they are slight, so as scarcely to attract attention, as languor or the appearance of fatigue. A dusky aspect of the surface may occasionally be observed during the few hours preceding the attack. In some children the first symptom is chilliness, and occasionally a distinct chill occurs. In the adult a chill is ordinarily the first symptom. With or without the initial chilliness, febrile movement occurs, of variable intensity according to the severity of the type, and accompanied by such symptoms as usually arise in a febrile state of system, as cephalalgia, anorexia, and thirst. The pulse rises to 110, 120, or more per minute, the temperature to 102°, 103°, or 104°; the skin is hot, face flushed, and the eyes bright. Even in cases that are not malignant or grave, and that give indications of a favorable result, there is often more or less stupor, with transient delirium and sudden starting or twitching of the extremities, showing that the cerebro-spinal axis is involved.

Vomiting is a common symptom in the beginning of scarlet fever, occurring before the appearance of the efflorescence. It therefore has diagnostic value when the nature of the case is still doubtful. In some patients it is an initial symptom, but in others some hours have elapsed when it occurs. I recorded its presence or absence in 214 patients, with the following result: present in 162 patients, absent in 52. In severe forms of the disease it is rarely absent, and if it do not occur it is probable that the case will be mild, requiring little treatment, and having a favorable termination. In epidemics of unusual mildness the number of cases without vomiting may be in excess of those in which this symptom occurs. It appears to be due to functional disturbance of the cerebro-spinal system, and may therefore be properly regarded as a nervous symptom. In severe cases the vomiting is apt to be repeated, not only on the first but on subsequent days, and we shall see that in cases of great gravity, in which a fatal termination is not improbable, persistent vomiting, by which the food and stimulants so urgently required are rejected, interferes seriously with successful treatment. In a few cases embraced in my statistics nausea without vomiting was recorded. The bowels in ordinary scarlatina act regularly or are slightly constipated. Diarrhœa, which so commonly accompanies the persistent vomiting in malignant cases, if it occur in this form of the malady is slight and transient and due to accidental causes. The food, if it be given in the liquid form and cool, is usually taken readily, on account of the thirst, except when deglutition is rendered painful by the pharyngitis.

The symptoms pertaining to the nervous system vary according to the severity of the disease and the temperament of the patient. Many children during the progress of the common form of scarlet fever present a dull or apathetic appearance. They lie much of the time with their eyes closed; others are more restless, and not a few, if the fever be considerable, have occasional twitchings of the limbs and more or less headache. Eclampsia sometimes occurs on the first day, especially

in those predisposed to it, even when the subsequent course of the disease is mild and favorable. This complication, very grave and usually fatal when it occurs at a later stage, is in most instances, when it takes place on the first day, readily controlled by proper remedies and with little detriment to the patient. But if it be attended by high elevation of temperature and marked drowsiness, approaching the comatose state, it is very serious upon the first as well as upon subsequent days. Nervous symptoms occurring in the beginning of scarlet fever, when it has the ordinary favorable type, begin to abate in three or four days, but if they supervene at a later date, and especially in the declining stage, they possess more gravity, since they then not infrequently result from and indicate renal complication.

Early in the disease, nearly as soon as the commencement of the fever, the faucial and buccal surfaces become inflamed, as shown by redness, swelling, and tenderness. The physician summoned in the beginning of an attack will already, at his first visit, observe hyperæmia of the fauces, with points of deeper injection than over the general faucial surface, and soon the buccal surface also participates. The inflammation at first produces preternatural dryness, and this is followed by a viscid secretion. The papillæ of the tongue enlarge and become prominent, giving rise to the appearance known as strawberry tongue which is so common in scarlet fever. This state of the buccal and faucial membrane continues throughout the disease. A thin fur appears upon the tongue on the first day, and it increases on the second and third days, after which it is usually detached, exposing the surface of the organ, which has a deep red hue, but in not a few patients the fur remains or is reproduced as soon as shed. Except in the mildest cases the Schneiderian membrane also participates in the inflammation as the disease advances, so that a thin, irritating discharge containing leucocytes or pus-cells, flows from the nostrils. The skin is hot and dry, and cutaneous transpiration nearly checked. The respiratory system is rarely involved in any notable manner unless there be a complication. Many have no cough whatever, while others have a slight cough, due to the fact that the inflammation, of a catarrhal form, has extended from the fauces to the surface of the glottis. Slight acceleration of respiration, corresponding with the degree of fever, may also be observed. The kidneys commonly act regularly and normally during the first days, any serious impairment of their functions being rare before the close of the first week.

When the symptoms described above have continued from six to eighteen hours the efflorescence appears. It is first observed about the ears, neck, and shoulders, in reddish patches fading into the normal hue. These patches extend and unite, and in the course of a few hours the trunk and upper extremities, and finally the legs, are covered. The scarlatinous rash usually, when fully developed, resembles that produced by external heat or the application of a sinapism. It has been likened to the appearance of a boiled lobster, but there are numerous minute points of a deeper or duskier hue than the surface generally. In many patients the rash appears, especially over the abdomen and lower extremities, as minute, thickly set points, with the skin of normal appear-

ance between them. Henoch, of Berlin, says of scarlet fever: "In general, the moderate grades of eruption prevail, the skin, when seen from a distance, presenting a diffuse, more or less scarlet redness, while on closer inspection it is found that this redness is composed of innumerable red points closely situated together, and separated from one another by very small paler portions of skin. The dark-red points appear to correspond to the hair-follicles." On passing the finger over the efflorescence no distinct prominences are observed, but a sensation of roughness is sometimes imparted from engorgement of the cutaneous papillæ. The rash disappears on pressure, but it immediately reappears when the pressure is removed. Its slow return is evidence of sluggish circulation, and it indicates a grave and dangerous form of the malady. The color is then usually a dusky instead of a bright red. The efflorescence is most marked in dependent parts, as along the back, over the chest and abdomen, and in the flexures of the joints. Parts pressed upon by the bedclothes, which confine and intensify the heat, present a deeper coloration than other portions of the surface. Often, especially in mild cases, the rash is absent from portions of the surface where it commonly appears, while it presents its typical character elsewhere. Tardy and incomplete establishment of the rash when the symptoms indicate an attack of ordinary or more than ordinary severity is commonly due to some perturbating cause, especially diarrhœa. In the *London Lancet* for Aug. 16, 1879, cases are related of supposed scarlet fever without the rash, cases in which pharyngitis and stomatitis with the strawberry tongue occurred, without efflorescence upon the skin; but it is to be remembered, as stated above, that the inflammations which commonly attend or follow scarlet fever, particularly the pharyngitis and nephritis, not infrequently occur in those who have already had scarlatina, and occur more than once from fresh exposure to scarlatina patients. These inflammations, occurring under such circumstances, appear to be purely local maladies, produced by the scarlatinous virus; and it seems to me a question whether, in the so-called scarlatina without efflorescence, the inflammations which are present, and which undoubtedly have a scarlatinous origin, are not local in their nature, instead of being local manifestations of the constitutional disease. The burning and itching sensation produced by the rash increases the restlessness of the patient, and is sometimes the most annoying of the symptoms.

The temperature in the common favorable forms of scarlet fever usually varies from 101° in the mildest cases to 103° or 104° in those more severe. If it attain 105° or over, the case is properly designated grave or severe. The febrile movement ordinarily fluctuates but little from day to day till the fourth or fifth day, when, if the case be favorable and no complication occur, it begins to decline. The temperature is as high in the beginning of the attack as subsequently.

The symptoms pertaining to the digestive system during the initial period of scarlet fever have been sufficiently described. The subsequent symptoms referable to this system do not differ materially from those present in the beginning, except the absence of vomiting. The lips are dry and often cracked. The inflammation of the mouth and throat

continues, with anorexia and thirst. With the decline of the disease the appetite gradually returns, but it is not till the close of the second week that it is fully restored. Great and continued disturbance of the digestive apparatus, seriously interfering with the nutrition, pertains to the malignant forms of scarlet fever.

The urine is high-colored, and in robust children during the first days of scarlet fever it frequently deposits urates on cooling. Gee, who has carefully investigated the state of the urine in scarlet fever, says that the quantity of water is diminished and the urea is not necessarily increased during the pyrexia; that the chloride of sodium is diminished till the fourth, fifth, or sixth day, and that the phosphoric acid is diminished during the climax of the pyrexia, though not in the first three or four days. In one case he made a daily estimation of the amount of uric acid, and found it greatly diminished on the second and third days, normal on the fourth, and much increased on the fifth. He believes that similar variations are common in the quantity of the products excreted in the urine. Bile may also appear in the urine, coincident with a yellow tinge of the conjunctiva.[1]

The duration of scarlet fever varies in different cases. If the attack be very mild, with little efflorescence, the febrile movement may decline by the fourth or fifth day; but if the disease be severe, little or no amelioration of symptoms may occur before the twelfth or fourteenth day, even when no complication has occurred to increase the temperature or cause aggravation of symptoms. Oeterlony, who estimated the duration of scarlet fever from the commencement of febrile symptoms to "the disappearance of fever, with marked improvement in leading symptoms," . . . . "found that the average duration of the disease in forty cases was six and one-sixth days. The minimum duration in a very slightly marked case was three days: the maximum duration was fourteen days." In general, prolongation of fever beyond the usual time is due to some complication—more frequently to unusually severe pharyngitis, with accompanying cellulitis, than to any other cause.

The malady whose commencement was so abrupt declines gradually. In ordinary cases, by the close of the first week or in the beginning of the second the rash becomes less and less distinct, and finally disappears, as do also the redness and swelling of the buccal and faucial surfaces. The engorgement of the tonsils and of the papillæ of the tongue subsides, the appetite returns, the countenance brightens and becomes natural, and the child, who during the height of the fever scarcely noticed objects or noticed them with indifference or even repugnance, can be amused as before his sickness.

Desquamation succeeds. This begins at about the sixth day, and is not completed till the tenth or twelfth day; often not till the close of the third or in the fourth week. The amount of desquamation corresponds with the intensity and duration of the efflorescence, or rather of the dermatitis which produces the efflorescence. If the efflorescence have been slight and partial, it will be slight, perhaps scarcely appreciable, but if the rash have been general, full, and protracted, exfolia-

[1] Article on scarlatina in Reynolds's System of Medicine.

tion occurs upon every part. It begins about the face and neck, and within a day or two appears upon other parts. Where the skin is thin the epidermis as it is detached presents a furfuraceous appearance; where it is thick, as upon the palms of the hands or soles of the feet, it separates in layers of considerable thickness.

Such is a brief description of scarlet fever when it pursues its normal course without any disturbing element, but there is no other disease in which complications and sequelæ so frequently occur. The liability to them renders the prognosis in every case doubtful. They largely increase the percentage of deaths. They occur both in mild and severe forms of scarlatina.

The difference in type in different cases and epidemics has already been alluded to. Scarlet fever is sometimes so mild, and its symptoms so slight, that the diagnosis is necessarily uncertain. In the spring of 1866 I was called to an infant thirteen months old who had slight pharyngitis and an indistinct rash over a part of the surface. In two days the eruption had disappeared, and the health within a day or two was apparently fully restored. Diagnosis would have been doubtful except for sequelæ which clearly indicated the scarlatinous nature of the attack. In another instance two children passed through the entire course of scarlet fever playing every day in the street. Although the intelligent grandmother saw the rash upon them, its nature was not suspected, as it was midsummer and cases of prickly heat common, till nearly two weeks afterward, when one of the children had nephritis and anasarca ending fatally. In cases so mild as these the heat of surface is but slightly increased, the pulse but little accelerated, and the rash usually does not occupy so much of the surface as in ordinary cases; the appetite is not lost, though diminished, and the thirst is moderate.

Between scarlet fever so mild that it terminates in four or five days, and that of the grave or malignant type presently to be described, all grades of severity exist. Scarlet fever occurs in all forms from mild to severe, but certain symptoms characterize grave or malignant cases—symptoms which are absent or much less prominent in ordinary scarlet fever. Therefore the grouping of cases according to the type is proper, and it facilitates the studying of the disease.

Grave Form (malignant scarlet fever).—This form of the disease is in some epidemics common, while in others it is rare. The symptoms which characterize it are severe from the beginning, those of the nervous system predominating at first, such as intense cephalalgia, restlessness or stupor, sudden twitching of the muscles, and perhaps delirium, or even convulsions. Many pass rapidly into coma and die within two or three days, succumbing to the intensity of the scarlatinous poison while the malady is still in its commencement. The rash is dusky. It disappears by pressure, and returns slowly when the pressure is removed, showing extreme sluggishness of the capillary circulation. Some patients are very drowsy, lying in a semi-comatose state except when aroused, and if aroused are very restless. Others are constantly restless. If placed in one position on the bed, they throw themselves in another in a half-conscious or unconscious state. They do not speak,

or they mutter like those affected by the graver forms of typhus, calling the names of playmates or talking incoherently about things which interested them when well. The thermometer placed in the axilla is found to rise above 103°, which is a safe average, to 105° or even 107°, and the heat of the surface is pungent except when the case approaches a fatal termination, when the extremities, ears, and nose may be cool while the trunk and head are extremely hot. The pulse from the first is rapid, ranging from 130 as the minimum in a malignant case to a frequency which can scarcely be counted. A very frequent pulse is nearly always feeble and compressible. Irritability of the stomach is one of the most common symptoms in grave cases, so that many patients immediately reject the nutriment and stimulants which are so urgently required to sustain the vital powers. The vomiting, therefore, if frequent and severe, greatly increases the danger, and in not a few instances this symptom is associated with diarrhœa, which also tends to increase the prostration.

Severe and dangerous nervous symptoms, due to the intensity or activity of the scarlatinous poison, occur chiefly within the first three or four days. Grinding the teeth, sudden muscular twitching, delirium, convulsions, and profound stupor occur for the most part within this time. Afterward the danger is mainly from exhaustion, unless in the second week or subsequently, when nervous symptoms may arise from uræmia.

Those who survive the onset of malignant scarlet fever often have in the course of a few days severe pharyngitis with extension of the inflammation to the lymphatic glands and connective tissue around the angle of the jaw. These inflammations cause more or less external swelling. The faucial turgescence around the entrance of the larynx, with the accompanying secretions of viscid mucus or muco-pus, often causes noisy respiration, and many at this stage of the attack breathe with the mouth constantly open to facilitate the ingress of air.

Ordinarily, no discharge occurs at first from the nasal surface, but as the disease continues, if the type remain severe, defluxion of thin muco-pus takes place from the Schneiderian surface, which frequently excoriates the cheek. The lips also are frequently sore and swollen.

In malignant cases the disease is more protracted than when the type is mild. Thus in a recent case in my practice the rash was still distinct at the close of the second week, though the temperature had fallen from 105° to 102° and some desquamation had appeared. Long continuance of the febrile movement is, however, oftener attributable to some inflammatory complication than to the primary disease.

In all epidemics of a severe type cases now and then occur in which the poison is so intense, or it acts with such frightful energy, that death occurs even within the first day. The patient is overpowered at the outset of the disease by the virulence of the specific principle, perishing in coma, preceded perhaps by convulsions. The autopsy in such cases reveals hyperæmia of the brain and cranial sinuses, blood of a dark red color, capillary hemorrhages in various parts, a flabby heart, and perhaps some engorgement of the spleen and kidneys.

Usually, malignant scarlet fever exhibits its severe type from the

first, but cases sometimes occur which seem mild and favorable for a few days, when severe symptoms suddenly supervene. This change from a mild to a dangerous disease is, however, most frequently, I think, due to some complication.

Irregular Forms.—Deviation from the normal type in scarlet fever is usually due to some perturbating cause, which is often a preëxisting or coexisting disease, or a disordered state of system through causes distinct from scarlatina. Thus, a little girl in my practice had the symptoms of scarlet fever, such as febrile movement and inflammation of the buccal and faucial surfaces, nearly a week before the scarlatinous eruption appeared. During this time the patient had an intestinal catarrh, with diarrhœa, which declined when the rash occurred. This intestinal disease was the apparent cause of the irregularity in the malady. If scarlatina occur during a severe attack of entero-colitis attended by purging, the defluxion from the intestinal surface may be such that no efflorescence appears. Severe scarlet fever itself sometimes appears to cause gastro-intestinal catarrh so as to produce an afflux of blood toward the intestinal tract and away from the skin. Practitioners occasionally meet cases like the following, which I recall to mind: In a family where scarlatina was prevailing a little child early after the commencement of symptoms which seemed to be plainly referable to this exanthem was seized with vomiting and purging, which continued till death occurred on the third day. No efflorescence appeared on the skin, but the symptoms indicated the presence of severe intestinal catarrh, complicating and masking scarlatina. We are aided in the diagnosis of such cases by observing the faucial redness, and we may discover a faint efflorescence upon parts of the surface, as about the groin or in the flexures of the joints. In another instance an infant in the warm months, having protracted entero-colitis, the usual summer epidemic of the cities, had the characteristic symptoms of scarlet fever, which was present in the family, but the diarrhœa continued and no rash appeared.

In one who is much reduced by an antecedent disease, especially if, like the intestinal catarrh mentioned above, it produces a decided afflux of blood away from the surface and toward the interior of the body, the eruption is commonly tardy in its appearance, indistinct, or wholly absent. Thus, severe inflammations of internal organs not infrequently render scarlet fever irregular. On the other hand, some maladies occurring in connection with this exanthem do not change its symptoms, but themselves undergo modification. Pertussis may be cited as an example, the cough of which is sometimes modified by an intercurrent attack of scarlet fever, the symptoms of the latter disease undergoing little change.

Scarlet fever may also be irregular without any apparent perturbating cause. In 1867 I attended a young lady whose previous health had been good, and whose brother was sick at the time with scarlet fever. She had considerable febrile movement, with severe pharyngitis, and, though her surface was repeatedly examined, no efflorescence was seen. Two weeks subsequently she was affected with severe nephritis, anasarca, effusion into at least one of the pleural cavities, œdema of the lungs, and

according to my diagnosis, hydro-pericardium, the case ending fatally. Rilliet and Barthez state that a second attack of scarlet fever is more likely to be irregular than the first. Probably this opinion is correct, especially if only a short time have elapsed between the two seizures. Still, as we have already stated, both seizures may be typical, and the second more severe than the first.

It would be impossible to make a clear and positive diagnosis of certain cases of irregular scarlet fever, in which cerebral, pulmonary, or gastro-intestinal symptoms predominate, were it not for the fact that they occur in connection with other cases of scarlet fever or are followed by sequelæ which evidently have a scarlatinous origin.

Occasionally, the eruption, if it be intense or if a certain condition of system be present in the patient, is accompanied by more or less extravasation of blood-corpuscles from the capillaries, usually in points, so that the redness does not entirely disappear on pressure. In rare instances certain of the exanthematic fevers present an extreme hemorrhagic character, so as to be beyond the reach of remedies, and of necessity speedily fatal. Hemorrhagic cases of this severe form are probably more common in variola than in the other fevers, but I have met a notable case in what was diagnosticated scarlatina. In June, 1881, a man in his thirty-second year, whose previous health had not been good, though he had no defined ailment and had been able to follow his occupation of harness-maker, suddenly became very ill, with high febrile movement and faucial inflammation, attended by marked prostration. After some hours an intense eruption of a scarlatinous appearance covered nearly the entire surface, and on the following day hemorrhages began to occur. The urine contained a large proportion of blood; each conjunctiva was raised by hemorrhages underneath (ecchymosis), so that its natural color was lost, the eyelids were closed with difficulty, and blood flowed from the nostrils, gums, and under the skin, forming hemorrhagic points and blotches. One of the consulting physicians, perceiving the resemblance to hemorrhagic variola as described by Hebra, suspected that we had a case of this formidable malady to deal with, but the time for the appearance of the variolous eruption passed by without its occurrence. Death took place on the fifth day. The temperature during the sickness was high, though the record of it has been mislaid. Fortunately, such severe hemorrhagic cases, which are necessarily fatal, are rare.

Complications and Sequelæ.—Scarlet fever, if its type be severe, is in itself dangerous to life. Many, as we have seen, perish from its direct effects when it produces profound blood-poisoning. But, while the ordinary epidemics of this malady are necessarily attended by a large mortality from the virulence and depressing effect of the specific principle, unfortunately, of all the diseases of modern times, scarlatina ranks first as regards the number and gravity of its complications and sequelæ, so that nearly or quite as many perish from these as from the direct effects of the poison.

Nervous accidents occur chiefly at two periods—to wit, in the first days, when they are due to the severity and malignancy of the malady and to the impressible nervous temperament of the child, and in the de-

clining stage, or after the termination of the fever, when they occur from uræmia. If the type be malignant, delirium, jactitation, profound stupor, and convulsions frequently occur on the first and second days; and these are symptoms which properly excite the utmost alarm and demand all the resources of our art, since they indicate a form of the disease which frequently ends in speedy death. The eyes have a dull or wild expression, the conjunctiva is suffused, the heat of surface pungent, the pulse rapid and compressible or feeble, rising above 150, even to 200, per minute, and the temperature is always elevated to a degree that involves danger, the thermometer not infrequently indicating 105° or 106°. But this severe form of scarlet fever, attended by so great elevation of temperature, is much less dangerous than in former times, even though it be complicated by delirium and convulsions, since we no longer hesitate to reduce bodily heat, when excessive, by the free use of cold baths, and have discovered potent agents in the bromides and chloral for controlling convulsions. Nevertheless, not a few perish in the commencement of scarlet fever with predominating cerebral symptoms, as delirium or eclampsia, followed by coma, under the best possible treatment. Sometimes the symptoms have closely simulated those of acute meningitis, and if the rash have been delayed and the sore throat is as yet slight, the physician may suspect that he is dealing with this disease; but autopsies in such cases show no inflammatory lesions, but only congestion of the cerebral and meningeal vessels.

As is stated in a preceding page, in every case of normal scarlet fever inflammation of the faucial surface is present, as indicated by redness, tenderness, and increased secretion of mucus or muco-pus. It precedes the efflorescence on the skin, and is announced by pain in swallowing and on pressure with the fingers behind and below the angles of the jaw. In that form of scarlet fever which has been designated anginose the pharyngitis is severe, and is a prominent element in the malady, the uvula, the pillars of the fauces, and the faucial surface in general being infiltrated and swollen. Nevertheless, this inflammation, with the accompanying tumefaction, is properly a part of the disease, rather than a complication, if it abate with the subsidence of the scarlet fever or begin to abate soon after, and if it produce but slight destructive change in the tissue of the neck. The secretions from the fauces may be foul and offensive; even superficial ulcerations or gangrene may occur upon the faucial surface, causing it to present a dark brown or jagged appearance, and the tissues of the neck may be infiltrated to a certain extent, and we designate the disease a form of scarlet fever under the title anginose. But when this condition is greatly aggravated, so that extensive infiltration and swelling of the tissues of the neck occur, with an amount of ulceration or gangrene which in itself involves danger, continuing after the primary disease abates, prolonging the fever and reducing the strength, it is proper to regard the state of the throat as a complication. In addition to the pharyngitis, which is severe as described above, the sides of the neck around the angles of the jaw become swollen, hard, and tender. The inflammation has been propagated to the deeper structures of the neck. Poisonous substances, the result of decomposition or vitiated secretions, traverse the lymphatic

vessels from the faucial surface, and, being intercepted in the lymphatic glands, cause adenitis, and the inflammation extends from the glands to the adjacent connective tissue, which becomes hard, tender, swollen, and infiltrated with inflammatory products. This tumefaction sometimes begins by the second or third day, but it is usually about the close of the first week or in the beginning of the second week that it becomes so considerable as to constitute a source of danger and anxiety. It is in most cases bilateral, though one side may begin to swell before the other and remain larger throughout.

In severe cases of this complication the tumefaction extends from ear to ear, filling up the space below and around the angles of the jaw and under the chin. Not only is deglutition difficult, but it is difficult to open the mouth sufficiently to inspect the fauces, and attempts to do so cause much pain. The lymphatic glands, which lie in the inflamed area and participate in the inflammation, are greatly enlarged by hyperplasia, the round granular lymph cells multiplying so abundantly that the glands increase to many times their normal size. Most of the tumefaction is, however, due to extension of the inflammation to the connective tissue of the neck. The cellulitis, which resembles that occurring in other conditions, is attended by distention of the capillaries, the abundant formation of young round cells, and transudation of serum (Billroth). A moderate amount of tumefaction may disappear by resolution, but if it be considerable it seldom abates in this way, but by the tedious and exhausting process of suppuration or gangrene. If the swelling at its most prominent point present a reddish hue, all hope of producing resolution must be abandoned: it cannot be effected by any medicine or appliance within the resources of our art. The abscess which forms is likely to be diffuse, so as to involve danger of pyæmia, unless it be soon opened and properly washed out. With the discharge of the pus the swelling gradually softens and declines. In other cases gangrene results. The vessels in the inflamed part are compressed by the inflammatory products, so that they no longer convey the blood which is required for the purpose of nutrition. It is a law of the economy that whenever the circulation ceases, the tissues which receive their nutritive supply through the obstructed vessels lose their vitality. Hence gangrene occurs in all that portion of the swelling in which the circulation is arrested. The skin over it peels off, the dead tissue underneath is brown or dark, and soon, if life be prolonged, the slough begins to separate. The prognosis as regards this complication depends largely on the size of the slough. If it be large, death will probably result, since the strength of the system is already reduced by the primary disease, and the reparative process will necessarily be slow, while abundant suppuration tends to increase the exhaustion. In some of the worst cases of cervical gangrene which I have seen the slough has laid bare the muscles and vessels of the neck, producing in one case a cavity or excavation sufficiently large to admit a hen's egg. Often the slough extends under the skin, so that the deepest recesses of the cavity are not visible, and occasionally in cases which have ended fatally in my practice severe hemorrhage occurred from the concealed vessels. If the ulcerative or gangrenous process extend so deeply into

the tissues of the neck that hemorrhages occur, death is the common result; but if the destructive action be of moderate extent and other conditions favorable, we may expect recovery through cicatrization, with perhaps some deformity by contraction of the cicatrix.

When the inflammation of the connective tissue of the neck is extensive, involving both the lateral and anterior regions of the neck, the patient is in a perilous state. The cellulitis, when extensive and accompanied by much swelling, may produce œdema of the glottis, may obstruct respiration by compressing the air-passages or the laryngeal nerves, may cause compression of the jugular veins, and thus give rise to dangerous cerebral symptoms, or may lay bare and injure important muscles and nerves, as we have seen. If the ulceration or gangrene be extensive, and death do not occur by hemorrhage from arterial or venous twigs, septic poisoning may occur, increasing still more the fatal nature of the malady.

Some cases of this complication are melancholy in the extreme, as one related by Cremen, in which ulceration of the pharynx occurred, allowing the escape of food and preventing deglutition. In severe scarlatinous pharyngitis the inflammation sometimes extends along the Eustachian tube, causing its occlusion. This accident will be considered when we treat of otitis media, another grave complication. It often also extends into the nares, causing catarrh of the Schneiderian mucous membrane, with discharge of muco-pus from this surface. Not infrequently ulceration or gangrene occurs in the faucial surface, producing more or less destruction of tissue and forming excavations which connect with the throat, while the cutaneous surface retains its integrity and is not even reddened. The following case shows how grave the complication which we are now considering sometimes is when the external surface of the neck is not involved, and how the inflammation by extension outward from the fauces may involve the middle ear.

Case 1.—Annie K———, aged two and a half years, and inmate of the New York Foundling Asylum, was well, except an eczema of the scalp, until the night of April 3, 1882, when she was attacked with vomiting and diarrhœa. She was feverish and drowsy, and at 2 P. M. on the 4th the scarlatinous efflorescence appeared upon her neck, body, and lower extremities; tongue coated; pharynx red; temperature (axillary) 103°; pulse 160. The symptoms and aspect indicated a grave form of the malady, and the usual sustaining treatment was ordered. On April 5th the temperature was 102°, pulse 144, tongue less coated, eruption fading, less stupor, no albumen in urine. April 6th, morning temperature 102°, pulse 160; passed a restless night; stools thin and too frequent; has grayish patches in the throat; P. M. temperature 103⅕°, pulse 150. April 7th, the diarrhœa continues, and she has a copious muco-purulent discharge from the nostrils; P. M. temperature 103⅖°, pulse 160. April 10th, the temperature has continued at about 103°; the patient is very sick, with a constant foul-smelling discharge from the nostrils; breath very offensive; temperature 103.5°, pulse about 180. April 12th, general appearance a little better, but the posterior surface of the fauces is completely covered by a thick pseudo-membrane; had four loose stools last night; temperature and pulse the same as at last record; a dark, offen-

sive, and jagged coating over the fauces, and a dark, foul discharge from the nostrils, as before; examination of the chest negative. April 14th, is much prostrated; temperature 104.5°, pulse rapid and weak; respiration noisy, diminished resonance over lower two-thirds of left side of chest; ulcers upon the mouth and tongue; fauces red and ulcerated. April 17th, pulse 150, temperature 100.5°; general appearance somewhat better, but the diarrhœa continues, and patches of a diphtheritic character have appeared upon the lips; moist râles in left side of chest. The symptoms continued nearly the same until April 23d, when she died. A dull percussion sound and distinct bronchial respiration were observed in the left scapular region during the last days of her life.

Autopsy nine hours after death by the curator, Dr. W. P. Northrup: Body well nourished; the tissues have a jaundiced hue; lips sore; on turning the head to one side pus runs from the left ear and dirty mucopus from the mouth. Brain normal; on opening the petrous portion of the left temporal bone the middle ear is found full of pus, which communicated freely with the external ear through a perforated membrana tympani; the Eustachian tube cannot be traced in the sloughy tissue, and a passage filled with pus extends from the ear to the fauces; opposite the greater cornua of the hyoid bone are two deep ulcers, each having about the diameter of a ten-cent piece, with sloughy and offensive base and sides; the left ulcer communicates by a ragged and wide sinus with a dark and sloughy cavity of about four drachms capacity; this cavity is located in the neck under the angle of the jaw, apparently occupying the site of a disintegrated gland, and it opens upon the surface of the fauces. The surface of the larynx has a dusky, dirty appearance, sprinkled with little cheesy-looking spots, and covered by a dirty, foul-appearing liquid, as if some of the ichorous pus had escaped into it from the neck; about one and a half inches below the vocal chords there is an unmistakable pseudo-membrane; below this, near the bifurcation, the trachea has a bright-red color, as if a pseudo-membrane had been peeled from it, leaving the surface raw. The detachment of a pseudo-membrane from this part, if it did occur, must have been ante-mortem, for the organ had been carefully handled in making the autopsy. Between the apex of the left lung and the median line the tissues of the neck, dissected upward, are found indurated, yellow, and giving an offensive odor, showing that the cervical cellulitis had extended downward further than usual. The bronchial glands have undergone hyperplasia, being enlarged and hard. The right lung is normal; about one-half of the left lower lobe is consolidated, and when cut is found to be gangrenous and offensive. The liver is apparently somewhat enlarged; spleen normal in size; gastric mucous membrane has a congested appearance and is covered with mucus; mesenteric glands enlarged, pale, and firm; Peyer's patches swollen and pale; at lower end of ileum some pigmentation of these glands; in large intestine the solitary glands are enlarged, and a few of them pigmented; kidneys pale, cortex thickened, and markings indistinct. Microscopical Examination.—In the pia mater perhaps a little increase of cells; meninges of brain otherwise normal. The trachea shows well-marked diphtheritic inflammation; it contains a film of pseudo-membrane; evidences of inflammation occur also upon the laryngeal surface, though less marked than in the trachea. The solidified portion of the lung exhibits the ordinary lesions of broncho-pneumonia, with some interstitial change. In the kidneys we find parenchymatous nephritis, with some cell-growth in the Malpighian bodies.

The above case has been related at length, not only because it shows how severe and destructive the inflammation of the throat, extending into the tissues of the neck, sometimes is, but because four other complications or sequelæ were also present—to wit, otitis media, diphtheria, nephritis, and pneumonia. We see how formidable a disease scarlet fever sometimes is when attended by the inflammations to which it so frequently gives rise, for a child older and stronger than this, if thus affected, would inevitably have perished with the best possible treatment.

In localities where diphtheria is endemic, as in New York City and Paris, scarlet fever is often complicated by pseudo-membranous inflammation of the fauces and air-passages. In severe cases the Schneiderian as well as the faucial surface is covered with pseudo-membrane, so that it can be readily seen on inspecting the anterior nares. Occasionally, this exudation appears upon the laryngeal and tracheal surfaces, as in the case which I have related above and in others presently to be related, causing dangerous embarrassment of respiration. This complication sometimes begins almost at the commencement of scarlet fever, but in most instances it does not occur before the third or fourth day, and it sometimes does not appear till in the declining stage of the fever. When it begins, it intensifies the febrile movement and produces general aggravation of symptoms.

The elaborate treatise by Sanné, of Paris, on diphtheria contains a chapter entitled "Secondary Diphtheria." In it the author says, what all who are familiar with diphtheria will agree to, that secondary diphtheria does not differ in nature from the primary form, and that it exhibits a tendency "to occupy the organs which are themselves the seat of the more pronounced local determinations of the primitive malady. . . . . Diphtheria is seen in the course or sequel of numerous diseases. Some appear to have a special proclivity for engendering diphtheria; these are specific maladies: measles, scarlet fever, pertussis." Sanné's statistics relating to the seat of scarlatinous diphtheritic exudation are as follows:

Fauces alone attacked	15 cases.
Fauces with larynx attacked	4 "
Fauces with nasal fossa attacked	8 "
Fauces with larynx and nasal fossa attacked	4 "
Fauces with larynx and bronchi attacked	1 "
Fauces with nasal fossa and lips attacked	1 "
Fauces with lips and skin attacked	1 "
Fauces unaffected	3 "
Diphtheria generalized	2 "
Larynx only affected	2 "
Nasal fossa	1 "

The opinion of so good an observer as Sanné, that when in scarlet fever, pseudo-membranous exudation appears upon the mucous surfaces which are the seat of scarlatinous inflammation, diphtheria has supervened, and not a croupous form of scarlatinous phlegmasia, carries with it great weight.

Nevertheless, one of the most difficult problems which we have to deal with in certain cases is to distinguish diphtheritic from non-diphtheritic inflammation; and I see no reason why the scarlatinous inflam-

mation when intense may not be sometimes membranous. We know that in some cases of dysentery a fibrinous exudation occurs upon the surface of the colon; that in croupous pneumonia fibrin exudes into the bronchioles and alveoli of the lungs; and that physicians in localities where there is no diphtheria meet, though at long intervals, cases which they designate croupous pharyngitis and laryngitis; and it seems probable that the intense inflammation of anginose scarlatina sometimes produces the same exudation. Moreover, it is very difficult to distinguish in the swollen fauces between a membranous exudation and ulceration or superficial gangrene so common in malignant scarlet fever. The grayish-white surface, jagged and foul, may be the one or the other, an exudation or a sphacelus, and in certain instances it is impossible to discriminate between the two conditions at the bedside.

Diphtheria complicating scarlet fever occasionally begins nearly simultaneously with the latter. Henoch states that exceptionally he has observed suspicious patches upon the fauces before the appearance of the scarlatinous eruption upon the skin; and he adds: "I have had repeated opportunities of observing this unusual beginning. In such cases we must ask ourselves whether the first affection was really connected with the second, or whether the former was a true primary diphtheria, rapidly followed by scarlatina. This opinion is favored by the fact that I had only observed such cases in the hospital, in which infection with various forms of contagion can scarcely be avoided."

But usually it is not till the third or fourth day of scarlet fever that this complication begins. The patient has been progressing favorably with the fever, till on a certain day a marked aggravation of symptoms occurs. A higher temperature, more pungent heat, and the physiognomy of a more serious malady are present. On inspecting the fauces to discover the cause we observe a pellicle forming upon the tonsils and perhaps other portions of the faucial surface. Often the entire aspect of the case changes by the occurrence of this complication, a mild case of scarlet fever becoming grave and fatal in consequence. Thus in a case which I saw with Dr. Hardy, of New York, the membranous inflammation of diphtheria, commencing upon the fauces on the third day of scarlet fever, extended to the Schneiderian membrane, and thence along the left lachrymal sac to the eyelids, producing redness and swelling along the side of the nose and upon the cheek like that of erysipelas. A thick diphtheritic pellicle occurred upon the under surface of each eyelid on the left side, with great tumefaction of both lids, gangrene of the cornea, and destruction of the eye. The case soon ended fatally.

A pellicular exudation sometimes occurs in the larynx and trachea during the course of scarlet fever, as a thin film, rendering the respiration noisy, but the development of a thick and firm pseudo-membrane, so as to imperil the life of the patient from the stenosis in the air-passages, has been much less frequent in my practice than it is in primary diphtheria and in diphtheria complicating measles or pertussis. The following were cases of this severe complication occurring in a recent epidemic in the New York Foundling Asylum. In these cases the respiration was noisy, but the obstruction to breathing was apparently

due to infiltration and swelling around the aperture of the glottis, more than to the pseudo-membrane, which the autopsies showed to be present.

Case 2.—A child aged three and a half years, who previously had symptoms of mild catarrhal croup, with moderate redness of the fauces, sickened with scarlet fever on Oct. 1, 1882, the rash being profuse and soon covering nearly the entire body. The axillary temperature was 103°, pulse 140; slight stridor in breathing and some cough; fauces very red, but free from membrane. Oct. 2d, restless, sleeping but little; has vomited four times. Oct. 3d, temp. 103.5°, pulse 120; fauces much swollen; still vomiting; rash abundant. 4 P. M., temp. 104.3°, pulse 128; tongue clean; some discharge from nares; urine not albuminous, but its quantity diminished. Oct. 4th, aspect that of very severe sickness; profuse discharge from nostrils; fauces of a deep red color, and a pseudo-membrane over tonsils and uvula; tumefaction along the sides of the neck; temp. 104°, pulse 140; breathing moderately stridulous; urine is passed more freely than yesterday; evening temp. 105°. Oct. 6th, croupy symptoms more marked; tonsils and uvula greatly swollen, so that the fauces are almost occluded; temp. 103.5° breathing difficult, but apparently sufficient oxygen is received; profuse nasal discharge, and other symptoms as before. About 1.30 P. M. he was raised to take some milk, and suddenly became asphyxiated. His face was dusky, the eyes protruded, and he voided urine and feces. Dr. Swift, who attended the child, and to whom I am indebted for this history, immediately performed tracheotomy, which gave temporary relief by the expulsion of a considerable quantity of pseudo-membrane through the opening. On the following day the respiration again became obstructed at some point below the canula, so that it could not be removed; the features grew livid, and death occurred in convulsions twenty-six hours after the tracheotomy.

The autopsy was made by Dr. W. P. Northrup, curator of the Asylum, who found the pharynx covered by a membrane which was traced to the posterior nares; larynx, trachea, and bronchial tubes as far as the third divisions, covered with membrane; portions of the tracheal surface denuded, and the mucous membrane underneath of a bright red color and smooth.

Case 3.—Katie, aged six and a third years, was returned to the Asylum on Nov. 18th. Three days later (Nov. 21st) she had sore throat, reddened fauces, coated tongue, and a faint rash upon the neck, chest, and arms; eyes injected; temp. 102°. In the afternoon temp. 103°; eruption still faint. Nov. 22d, temp. 103.5°; an eruption on chest, abdomen, arms, and legs in patches. Evening, temp. 104°; voice clear. Nov. 23d, temp. 103.5°; tongue red; fauces deeply reddened, but without any visible pseudo-membrane; the scarlatinous eruption has appeared over a considerable part of the surface. On the 24th a pseudo-membrane occurred over the tonsils and adjacent faucial surface; her respiration became labored, and death took place from dyspnœa at 11 P. M.

Autopsy: Naso-pharynx covered by a thick fibro-purulent membrane. Larynx contains a well-marked pseudo-membrane, but not continuous. Trachea covered by a pseudo-membrane, continuous over most of its surface, but in places broken and flaky. Where it is detached the mucous membrane is seen underneath, dusky and deeply injected. At the root of the lungs the pseudo-membrane can be traced along the tubes about an inch in all directions. Nothing noteworthy in the other lesions.

In a fourth case of scarlet fever, in which death occurred after an illness of three weeks and from gradually increasing dyspnœa, it is stated in the records of the autopsy that the larynx was free from a pseudo-membrane; a thin film extended over a considerable part of the trachea.

Coryza frequently commences at or about the time of the pharyngitis. The inflammation of the Schneiderian membrane is continuous posteriorly with that of the fauces, and is announced by redness and swelling, inability to breathe freely through the nostrils, and an irritating ichorous discharge. Simple coryza in itself involves little danger, though it is an unpleasant complication, and in the nursing infant it may interfere with suckling. Diphtheritic coryza, on the other hand, which is frequently present when diphtheria complicates scarlet fever, involves danger, since it is apt to cause ulcerations, hemorrhages, and septic poisoning. When the local symptoms are unusually severe and the discharge abundant, it is probable that inflammation has in some cases extended to the antrum of Highmore.

Inflammation of the middle ear is another unpleasant and not infrequent complication. It is due to extension of the catarrh from the pharynx along the Eustachian tube to the tympanum. In a considerable proportion of cases of otitis media this tube is occluded by the infiltration and swelling of its mucous membrane, so that the muco-pus escapes with difficulty or is retained. Hence severe earache, an increase of the febrile movement, and outward bulging of the membrana tympani occur. Sometimes headache or other cerebral symptoms arise, probably from the fact that the meningeal artery, which supplies the meninges, is connected by anastomosing branches with the tympanum. In one of the cases related above it will be recollected that the ulceration and abscess extended from the fauces to the middle ear, the entire Eustachian tube having disappeared in the ulcerative process.

Frequently, the otitis escapes detection, its symptoms being masked or obscured by the general disease, until the membrana tympani is perforated and otorrhœa begins; but by careful examination the nature of the complication can usually be ascertained before the ear is injured to this extent, for a patient too young to speak will often press with the fingers against the painful ear or lie with the ear pressed upon the pillow, evidently having an increase of suffering if placed in any other position. One old enough to speak and in proper mental condition makes known the earache as soon as it occurs.

The mucous membrane of the tympanum, red and swollen from inflammation, secretes muco-pus abundantly; and this, pent up in the cavity, must obtain an exit before relief occurs. It is well if the secretion escape, though with difficulty, down the Eustachian tube. The destructive action of the pus upon the delicate structure of the ear is often such that, within a few days, irreparable harm is done and more or less deafness results. Relief can occur, if the Eustachian tube remain closed, only by perforation of the membrane and the discharge of the secretions into the external meatus. When this takes place the inflammation in the most favorable cases gradually abates, the aperture in the drum closes, and the integrity of the auditory apparatus is preserved. In severe cases the mastoid cells participating in the inflam-

mation become filled with muco-pus and tender to the touch, and often the collateral œdema causes tumefaction and narrowing of the external ear, which subside with the discharge of pus from the tympanum.

Unfortunately, there is for many a more melancholy history—a more destructive inflammation, involving permanent impairment or total loss of hearing. This is especially apt to occur in strumous or feeble children. All grades of inflammation and destructive action occur in different cases. The perforation in the drum-membrane may be large or the membrane may be completely destroyed, and the detached ossicles escape one by one into the external meatus, and in a few instances, fortunately rare, this occurs in both ears, producing complete and permanent deafness. In my own practice this has never occurred, but I have met one or two adults who were totally deaf from this cause.

The mucous membrane which lines the bony wall of the middle ear has the function of the periosteum, and therefore, when inflamed and subjected to pressure, is liable to ulcerate. As in other parts of the skeleton under similar conditions, superficial caries or necrosis of the underlying bone is apt to occur. The carious or necrotic process may extend to the mastoid cells. An offensive otorrhœa, continuing for months or years, indicates the persistence of this pathological state of the tympanum, which is rendered so obstinate by the presence of dead bone. A moment's survey of the anatomical relations of the middle ear shows the danger to which these patients are liable. A thin bony septum, perforated with bloodvessels and sometimes containing congenital apertures, separates the tympanum from the cranial cavity above. Posteriorly lie the mastoid cells, connected with the tympanum by one large and several small apertures. Anteriorly is the commencement of the Eustachian tube, and in close proximity to the tympanum lies the carotid canal, and at one point also the superior petrosal sinus. Virchow has shown how inflammation extending from the ear in otitis media sometimes produces such compression of the veins or sinuses by the swelling from the infiltration and exudation that the circulation is arrested, and the fibrin contained in the blood of these vessels is precipitated, forming thrombi, with the most disastrous effect upon the individual. Pus may also burrow in the interstices of the bone, causing great pain, or the pent-up secretions, having no outlet for escape, may in time undergo caseous degeneration, producing the conditions in which tuberculosis so often originates.

Death not infrequently occurs in chronic otitis media in another way. The otorrhœa, after months or years, suddenly ceases, the child complains of constant severe headache and is feverish, and the case ends in coma, preceded perhaps by convulsions. Meningitis has occurred, produced by extension of the inflammation through the thin bony septum which divides the tympanum from the cranial cavity, and at the autopsy hyperæmia of the meninges, fibrin, pus, perhaps softening of the brain and an abscess, are found in the portion of the encephalon adjacent to the tympanum. Therefore, otitis media, though it often ends favorably, is in many patients an obstinate, dangerous, and even fatal sequel of scarlet fever.

The complication known as *scarlatinous rheumatism* is regarded by

some as a synovitis, but its symptoms, especially its shifting from joint to joint, seem to ally it to the rheumatic affections. In some epidemics it is common. It usually begins toward the close of the first week or in the second week, and its common seat is in the ankle, phalangeal, and wrist joints. It is attended by very little swelling in most patients, though the joints are tender and painful on pressure. It does not seem to retard convalescence materially, but it produces suffering and involves danger as regards the heart. It subsides in a few days with the ordinary treatment of acute rheumatism, and even without special treatment, the chief danger being that, as in idiopathic rheumatism, endocarditis may arise, with permanent crippling of the valves. The following was a case of valvular disease having this origin. It occurred in my practice.

Case 5.—Freddy M., aged four years, sickened with scarlet fever March 6, 1879. The usual vomiting occurred on the first day, and the temperature was 104°. The case progressed favorably till March 14, when he complained of pain in both wrists, both ankles, and both knees. On March 17th the general condition was good, the urine contained no albumen, and apparently few urates, but he still had pain in the joints of the upper and lower extremities and in the back; pulse 140, temperature 103°; breathes with a slight moan; urates in the urine, but no albumen. A distinct mitral regurgitant murmur is now heard for the first time. Under the use of salicylate of sodium the pain in the joints soon ceased, but the mitral murmur is permanent.

The following prescription is for a child of five years:

℞.—Ol. gaultheriæ . . . . . ʒj.
Sodii salicylat. . . . . ʒiij.
Syrupi . . . . . fʒij.
Aquæ . . . . . fʒiv.—Misce.
Sig.—Give one teaspoonful every four hours in water.

Of the serous inflammations complicating scarlet fever, pericarditis has been, according to Rilliet and Barthez, most frequently observed. In this country it is probably more common than is usually supposed, but it is less frequently detected than pleuritis, the symptoms of which are more conspicuous.

The following case, which occurred in my practice, was an example of this complication:

Case 6.—C———, girl, aged five years and ten months, sickened with severe scarlet fever on April 4th. Was delirious; pulse 158; had vomiting and constipation. April 10th, pulse varies from 124 to 153, no delirium; a considerable quantity of urates in the urine. April 11th, has to-day, for the first time, severe pain in the epigastrium, with tenderness and moderate distention. Otherwise symptoms favorable, but severe; pulse 140; respiration moderately accelerated, and vesicular in every part of the chest. From this date the symptoms continued about the same till April 14th, when the dyspnœa became more marked, and the action of the heart rapid and tumultuous. The epigastric pain, distention, and tenderness continued; the percussion sound was dull over the lower part of the chest; the dyspnœa became rapidly worse, although the pulse had considerable volume; and at 5 P. M. death occurred. At the

autopsy about one ounce of turbid serum, with a soft deposit of fibrin, was found in the pericardium. Each pleural cavity contained from six to eight ounces of transparent serum, and both lungs were readily inflated, except a little of the posterior portions of both lower lobes; no fibrinous exudation over the lungs. The liver extended four inches below the margin of the ribs, and upon its convex surface in the epigastrium, corresponding with the seat of the pain, was a rough patch of fibrin about one and a half inches in diameter. The bronchial mucous membrane was moderately injected, as was also that of the colon, and the kidneys appeared hyperæmic.

Among the serous inflammations which complicate or follow scarlet fever, pleuritis is one of the most important. It usually begins in the desquamative stage, and is frequently suppurative on account of the feeble state of the patient when it commences. It has, in my practice, been tedious, as all empyemas are, and it does not differ in its clinical history from the idiopathic disease. I have met cases of scarlatinous empyema in which, from opposition of the family or for other reasons, thoracentesis was not performed, and death occurred; others in which this operation effected a cure, and one at least in which the patient recovered by escape of pus through a bronchial tube and its expectoration. The pleuritis is seldom latent, or so masked by the symptoms of the general disease that it is liable to be overlooked. On the other hand, the cough, embarrassment of respiration, and pain referred to the affected side render diagnosis easy.

Dilatation of the heart is common in grave cases of scarlet fever, such cases as are properly termed malignant. It is indicated by a feeble and quick pulse. Acute infectious maladies, especially those of a malignant type and accompanied by high febrile movement, are very liable to cause parenchymatous degenerations in organs, prominent among which is granulo-fatty degeneration of the muscular fibres of the heart. This weakens very much the contractile power of these fibres. But early in malignant cases, probably before the muscular fibres are damaged, the contractile power of the heart is feeble from impaired innervation, the result of the general weakness. Hence this organ, when weakened by structural change and insufficiently stimulated through diminished innervation, may not fully empty itself during the systole, and consequently it becomes dilated. Dilatation of the heart and imperfect contraction of its auricular and ventricular walls facilitate the formation of clots in the cavities of the heart; and this appears to be the immediate cause of death in not a few instances. An ante-mortem clot occurring in any of the cavities of the heart necessarily seriously obstructs the circulation, unless it be of small size. Hence the dyspnœa, which may occur suddenly, and the change of pulse to one of marked feebleness and frequency. Large, firm white clots are most frequently found in the right cavities. They interlace with the chordæ tendineæ, lie even within the auriculo-ventricular opening, and send prolongations into the pulmonary artery and the cavæ. Associated with the white clots are dark, soft clots and fluid blood. The left cavities may be contracted and empty, or they may contain dark, soft clots or white ante-mortem clots. Clots in the left ventricle are some-

times prolonged into the aorta as far as the brachiocephalic branches, while those in the left auricle may extend to the pulmonary veins. If dilatation of the heart be so great that clots form in its cavities, speedy death is probable. Sometimes a patient passes through scarlet fever and appears in a fair way to recover, when he succumbs to some exhausting sequel distinct from the heart, and at the autopsy the heart is found dilated and containing whitish clots, which are probably antemortem, and which hastened death by obstructing the circulation. Under such circumstances this state of the heart is attributable in great measure to the complication which has weakened its contractile power.

The following was a case in point. It occurred in the New York Foundling Asylum:

Case 7.—R. A., aged three years, had scarlet fever, beginning March 23, 1882. The symptoms were favorable at first, but serious complications and sequelæ occurred, which were fatal. The record of April 18th reads: "Appears well nourished, but is anæmic; has otorrhœa; no œdema; skin desquamating; dulness on percussion over upper third of right side of chest, anteriorly and posteriorly; mucous râles and rude breathing over same area; fine râles posteriorly over lower part of left side of chest; pulse 160, respiration 68, temp. 101⅖°." April 20th, is feeble and takes nutriment with difficulty; tongue thickly coated; pulse 160, respiration 68, temp. 101⅖°. April 26th, condition about the same as at last record, but he is evidently weaker; the lips are ulcerated and fauces still swollen. May 2d, cannot speak distinctly; a brownish, foul-smelling secretion lodges on the spoon used in depressing the tongue; left side of face swollen. On the following night eight convulsions occurred, attended by orthopnœa, and mucous râles in the chest from pulmonary œdema. Diarrhœa supervened and the patient died about midnight.

Autopsy: Body moderately wasted and very white, several dark blue spots on scalp and face from hemorrhages underneath. A careful examination showed the presence of broncho-pneumonia in each lung, with considerable infiltration of the walls of the bronchi, and cylindrical dilatation of many of them; cavities of the heart dilated, so that this organ appears much enlarged, and its shape approaches the globular; its apex is rounded or obtuse; transverse diameter of the right ventricle, when its walls were open and drawn apart, was three and one-quarter inches; that of the left ventricle three and a half inches. Similar measurements of the heart of another child of about the same age, believed to be normal, were about one inch less in each direction. All the cavities contain white firm clots along with soft dark clots. Lesions observed in other organs were carefully noted, some of which were serious; but the immediate cause of death appeared to be imperfect contraction of the heart, and the formation of clots in its cavities.

There can be little doubt that *nephritis* in its milder form is much more common than was formerly supposed. A few years since little attention was given by a large proportion of physicians to the state of the kidneys, and the urine was not examined till dropsy made its appearance, which only occurs in the more severe forms of nephritis and is a late symptom. It is now known that catarrh of the renal tubes frequently occurs in a mild form early in scarlet fever, without causing albuminuria, dropsy, or any notable symptom. It may produce a smoky

color of the urine, and the appearance in it of granular epithelial cells, with an increase of mucus, but no albumen. With careful treatment and no exposure to cold, the renal catarrh abates with the decline of the scarlet fever. It is scarcely severe enough to merit the name desquamative, tubal, or parenchymatous nephritis, though it is a mild form of the same pathological state. Steiner states, as the result of many careful examinations of cases, that hyperæmia of the kidneys was always present in those who died early in scarlet fever, and that in a certain proportion of these cases catarrh of the renal tubules was present in addition to the congestion. Even in some who died on the second or third day he found cloudiness of the epithelium in the renal tubes, although the urine had not indicated such a change. The opinion has even been expressed that catarrh of the renal tubes is as common in scarlet fever as that of the bronchial tubes in measles; that is, it is a uniform element in the disease; but this appears to be an exaggerated statement, for others have failed to find any evidence of renal catarrh in certain cases.

The nephritis which gives rise to symptoms and therefore interests the practitioner, commonly begins in the declining period of scarlet fever or during the desquamative stage, and is in many instances plainly attributable to exposure to cold or to currents of air. It originates either during this period, or if it have previously existed as a mild renal catarrh, it now becomes aggravated. Dropsy, which always attracts attention, does not occur till the nephritis has continued for some time.

Why nephritis, with the subsequent dropsy, so frequently occurs after scarlet fever is not fully understood. Rilliet and Barthez attribute it to disturbance of the function of the skin. The fact has long been observed that the kidneys become affected nearly if not quite as frequently after mild as severe cases. Indeed, the chief danger in mild cases, when the patients are but a short time in bed and are soon allowed to go about, is from the nephritis. Chilling the surface and checking cutaneous transpiration appear to be the immediate cause of this inflammation in a considerable proportion of cases. Therefore, severe attacks of scarlet fever with abundant rash and desquamation, which require the patient to be kept in bed the proper time and in a warm room two or three weeks, appear to be less frequently followed by this renal disease than are milder cases which are more carelessly treated,

The most thorough and minute microscopic examinations of the state of the kidneys in scarlet fever which have come to my notice were those by E. Klein, published in the *Lond. Path. Soc. Trans.*, and illustrated by microscopic drawings. It appears from these examinations that the changes in the kidneys are complex, among which we recognize both those of parenchymatous or desquamative nephritis and interstitial nephritis; but we would infer that the interstitial nephritis is mild in degree and quite subordinate, or else confined to portions of the organ, from the fact that so many permanently and fully recover. The following is a résumé of Klein's examinations in twenty-three cases: We conclude from these microscopic researches that the anatomical changes of both parenchymatous and interstitial nephritis are commonly present in greater or less degree in cases of scarlet fever. If they are mild or con-

fined to portions of the kidneys, no symptoms occur; but if they are sufficient in extent or degree to impair the function of these organs, then symptoms, as albuminuria, diminution of urine, etc., appear.

1. *Parenchymatous Nephritis, Proliferation of Nuclei, Hyaline Degeneration of Arterioles. The Glomerulo-nephritis of Klebs.*—Klein found increase of nuclei (probably epithelial) upon the glomeruli and hyaline degeneration of the intima of minute arteries, especially marked in the afferent arterioles of the Malpighian bodies. The intima of these vessels was in places so swollen as to resemble cylindrical or spindle-shaped hyaline masses, and cause narrowing of the lumina of the vessels in which this degeneration occurred. Klein observed in some specimens so great hyaline degeneration of the capillaries of the Malpighian bodies that circulation through them was obstructed. In the more advanced or protracted cases this hyaline substance in the glomeruli began to assume a fibrous appearance. Bowman's capsule was considerably thickened. This hyaline degeneration of the Malpighian bodies Klein discovered in the earliest cases which fell under his observation.

Also in the earliest cases the multiplication or germination of the nuclei of the muscular coat of the arterioles was observed, with a corresponding increase in the thickness of the walls of these vessels. This change in the muscular element was found in the arterioles in different parts of the kidney, but it was most conspicuous in these vessels at their point of entrance into the Malpighian bodies; and it was distinctly noticed in other arterioles, both in the cortex and in the base of the pyramids.

In the glandular portion of the kidneys other anatomical alterations were observed, indicating parenchymatous nephritis. There were swelling of the epithelial lining of the convoluted tubes; multiplication of nuclei of epithelial cells especially in ascending tubules, which lay close to the afferent arterioles of Malpighian corpuscles; granular matter, and even blood, in the cavity of Bowman's capsule and in the convoluted tubes; cloudy swelling and granular disintegration of epithelium in some parts of the convoluted tubes; detachment of epithelium from the membrane of larger ducts of the pyramids in some cases. These parenchymatous changes are already known to the profession through the observations and writings of Dickinson, Fenwick, Johnson, John Simon, and others.

Klein, in commenting on the hyaline degeneration which he observed, states that Neelsen found the walls of the capillaries of the pia mater thickened, highly refractive, and of a lardaceous appearance in certain acute infectious maladies, as variola, typhoid fever, measles, and in one case of scarlet fever.[1] Usually, only a small portion of the capillaries were thus affected, most frequently at the point of division into branchlets. In a few instances Neelsen noticed degeneration of arterioles extending a considerable distance, with fusion of the intima, media, and adventitia, and chemical examination showed that the substance produced by this degeneration had similar properties to elastic tissue. Although the examinations by Neelsen relate to the pia mater, two of

[1] Archiv der Heilkunde, 1876.

his observations are especially interesting—first, that the hyaline change affects chiefly vessels near their point of branching; and, secondly, that the hyaline substance is of the nature of elastic tissue, for in the kidney in scarlatinous nephritis the arterioles undergo the change in question chiefly near their point of branching into the capillaries of the glomerulus; and the intima being the part which undergoes the hyaline change, it is probable, in the opinion of Klein, that the same substance is produced by the degeneration in walls of the vessels of the kidney which Neelsen observed in the pia mater, and therefore that it is of the nature of elastic tissue.

This hyaline degeneration of the arterioles is also very marked in the spleen in scarlet fever; and in studying the minute anatomy of the intestines and spleen in typhoid fever, Klein has found the same degeneration of the intima of the minute vessels. He believes that this hyaline change and the proliferation of muscle-nuclei which thus occur at an early period in scarlet fever in the renal vessels when the kidneys become affected are due to an irritating cause acting similarly to that in typhoid fever.

Klein calls attention to the interesting examinations of the scarlatinous kidney made by Klebs, who attributed the diminished urination and the uræmic poisoning in certain cases in which the kidneys do not exhibit any marked change to the naked eye, to what he designates glomerulo-nephritis. Klebs says: "In the post-mortem examination the kidneys are found slightly or not at all enlarged, firm, . . . the parenchyma very hyperæmic. Only the glomeruli appear, on close inspection, pale like small white dots. The urinary tubes are often not changed at all. Occasionally the convoluted tubes are slightly cloudy. The microscopic examination shows that there are neither interstitial changes nor proliferation of epithelium, the so-called renal catarrh generally supposed to be present in these conditions on account of the absence of other perceptible derangements; and there seems, therefore, leaving out the glomeruli, the congestion of the kidneys alone to remain to account for the symptoms during life." But that mere congestion is insufficient to produce the symptoms appears from the fact that it does not cause them under other circumstances. Klebs finds, "on microscopic examination of the glomerulus, the whole space of the capsule filled with small somewhat angular nuclei, embedded in a finely granular mass. The vessels of the glomerulus are almost completely covered by nuclear masses."

Klein, commenting on these examinations by Klebs, states that in all early cases which he examined he observed great abundance of nuclei of the glomeruli, but a condition like that described and figured by Klebs[1] he has seen in only a few glomeruli; for a general state of these bodies, as described by this observer, and such an excessive proliferation of the nuclei that the bloodvessels are completely compressed, was not seen in one of the twenty-three cases. Klein therefore questions whether the diminished urination and retention of urea in scarlet fever, when the kidneys do not exhibit any conspicuous catarrhal or other

[1] Handbuch der Pathol., p. 646, fig. 72.

change, is due, unless in exceptional instances, to compression of the vessels of the glomeruli by nuclear germination, but believes, rather, that the obstructed circulation, and consequent diminished urinary excretion, is largely due to the changed state of the arterioles. Klein adds that perhaps undue contraction of the arterioles, through stimulation by the blood-irritant, may also be a factor in causing arrest of circulation in the Malpighian corpuscles. As regards cases that perished early, he found the parenchymatous change slight, so that a careful examination was required in order to detect cloudy swelling and granular degeneration.

2. *Interstitial Nephritis.*—A second set of changes Klein observed in cases that died about the ninth or tenth day. In such cases he found changes due to interstitial, in addition to those produced by parenchymatous, nephritis. Round cells, lymphoid cells, or whatever else they should be called, were seen in the connective tissue of the kidneys. In the kidneys of those that died at the end of the first week after the commencement of nephritis, infiltration with round cells was observed in the connective tissue around the large vascular trunks. At a later stage this infiltration had extended into the bases of the pyramids and into the cortex. The gradual increase in extent and intensity of this infiltration was so decided in the cases which Klein observed, that he has no hesitation in concluding that when interstitial nephritis occurs it begins about the end of the first week, in the manner already stated—to wit, as a slight infiltration of the tissues around the large vascular trunks, and gradually extends, so that portions of the cortex, and rarely portions of the base of the pyramids, are changed into firm, pale, round-cell tissue, in which the original tubes of the cortex become lost.

The infiltration of the cortex with round cells, beginning at the roots of the interlobular vessels, spreads rapidly toward the capsule of the kidney, and laterally among the convoluted tubes around the Malpighian bodies. . . . In the course of this process considerable parts of the peripheral cortex, occasionally of a cuneiform shape, with the base nearest the capsule of the kidney, become changed into whitish, firm, bloodless, cellular masses, in which Malpighian corpuscles and urinary tubes are only imperfectly recognized, being more or less degenerated. In some cases attended by this infiltration of the cortex, Klein observed a more or less dense reticulation of fibres, especially around the interlobular arteries, containing in its meshes lymph-cells, chiefly uninuclear.

In a child of five years that died after a sickness of thirteen days, Klein found evidence of intense interstitial inflammation, and also emboli, consisting of fibrin with a few cells, in the arteries, both in those of large size and in the arterioles, chiefly where they enter the Malpighian corpuscles. He states that in the specimens which he examined the more intense the degree of interstitial change, the greater was the enlargement of the kidneys, and the more distinct also were the evidences of parenchymatous nephritis in the urinary tubes, which either contained casts or were in process of destruction. By being crowded with inflammatory products, especially cells, the Malpighian corpuscles were obliterated, undergoing fibrous degeneration. A very curious fact observed was the deposit of lime in the urinary tubes, first

of the cortex, and then also of the pyramids, at an early stage of scarlet fever, when the kidneys otherwise showed only slight change. Several observers, as Biermer, Coats, and Wagner, have each described a case of scarlet fever with interstitial nephritis, which they consider unusual; but Klein has apparently demonstrated, as we have seen, by a large number of microscopic examinations, that this form of nephritis is common after the ninth or tenth day.

Nephritis, in proportion to its extent and gravity, is accompanied by languor, febrile movement, thirst, loss of appetite and strength. At first the patient experiences but slight pain in the head or elsewhere and the quantity of urine is not notably diminished; but as the disease continues urination becomes less frequent and the urine more scanty. Albuminuria occurs, while the urea is only partially excreted, and therefore it accumulates in the blood. If the nephritis be so severe or protracted that this principle accumulates to a certain extent, grave symptoms occur, as headache, vomiting, apathy or restlessness, and, more dangerous than all, eclampsia, which is not unusual in these cases. Microscopic examination of the urine shows the presence in this liquid of blood-corpuscles, granular epithelial cells, and hyaline or granular casts, or both. The specific gravity of the urine is diminished. But a large quantity of albumen in the urine may render the specific gravity as high or higher than in health.

The altered state of the blood soon gives rise to transudation of serum, first observed in most cases as an anasarca occurring in the feet and ankles. The œdema, if not checked by treatment or through mildness of the disease, extends over the limbs, scrotum, and sometimes upon the trunk. It is well if the dropsy remain limited to the subcutaneous connective tissue, but unfortunately, it is apt to occur, if the nephritis continue, in and around the internal organs, producing, mentioned in the order of frequency, pulmonary œdema, effusion into the pleural and peritoneal cavities, the pericardium, the encephalon, and lastly into the connective tissue of the larynx, causing that very fatal complication, œdema of the glottis. Although this is the common order in which dropsies occur, exceptions are not infrequent. Even the anasarca may not be the first to appear, although in the vast majority of cases it has the precedence. Thus, Rilliet relates the case of a boy of five years who twenty days after the occurrence of scarlet fever, and six hours after the appearance of bloody and albuminous urine, had double hydrothorax, rapidly developed. As long as the hydrothorax continued no anasarca was observed, but as it declined anasarca appeared. Legendre cites a case in which œdema of the lungs occurred without anasarca or other dropsy. Occasionally, the anasarca and internal dropsies take place nearly simultaneously. The nephritis and consequent serous effusions usually appear within three weeks after scarlet fever ends, but cases occur in which the effusions are first observed as late as the fourth and fifth weeks. The patient may be considered to possess immunity from this sequel if he have reached the close of the fifth week after the abatement of scarlet fever without its occurrence.

The dropsy is usually acute, but it may assume the chronic form,

since the nephritis which causes it, happily curable in most instances, may, if neglected, become chronic. Whether the dropsy in itself involve danger depends in great part on its location. Anasarca and ascites may exist a long time with little suffering or danger, but a small amount of serum in certain other localities causes alarming symptoms and speedy death. Œdema of the lungs, hydro-pericardium, œdema of the glottis, and intracranial effusions are always dangerous, and the last two are sometimes fatal within twenty-four to forty-eight hours. Œdema of the lungs has been fatal within twelve hours from the appearance of the first symptoms of obstructed respiration.

Cerebral symptoms occurring during scarlatinous nephritis are probably sometimes due to the irritating effect of the retained urea on the nervous centre. In other cases the cause appears to be cerebral œdema or compression of the brain by effusion of serum within the ventricles and upon the surface of the brain. Headache, dull or severe, dilatation of the pupils or their oscillation in a uniform light, vomiting with little apparent nausea, are common symptoms of scarlatinous nephritis when it has continued a few days, and the excretion of urea is so diminished that this substance begins to exert its poisonous effect on the system. Such symptoms are frequently followed by somnolence, threatening coma, or by eclampsia, unless the patients are promptly and properly treated. In some patients that die of scarlatinous nephritis, death occurring in convulsions or coma, no appreciable lesions are observed within the cranium, unless more or less congestion, the fatal ending being attributable to the uræmia. In other instances we find an effusion of serum within the ventricles or upon the surface of the brain. Although the symptoms in scarlatinous nephritis and uræmia may appear very unfavorable, the prognosis is usually good under prompt and appropriate treatment. Thus severe convulsions and a degree of somnolence that bordered on coma may abate, and convalescence be fully established within a few days. Rilliet and Barthez announce ten recoveries in thirteen patients affected with convulsions due to this renal affection.

Anatomical Characters.—Scarlet fever being, as we have seen, a constitutional febrile disease of an ataxic nature, and accompanied by certain inflammations, necessarily affects the composition of the blood; but since this disease varies so greatly in type or severity, the state and appearance of this liquid also vary. At the autopsies of the more malignant cases we find the blood dark and fluid, with small, soft, and dark clots in the heart and large vessels. In other cases the clots are large, firm, and solid, as described in a preceding page. In malignant cases that end fatally Rilliet and Barthez state that both the large and small vessels of the cerebral meninges and the brain are found hyperæmic, but in a variable degree. In those who die in coma, preceded by delirium or convulsions, during the eruptive stage, the intracranial congestion is usually marked, with perhaps some transudation of serum, but without inflammatory lesions. The fibrin in scarlet fever remains in about normal proportion, except as it is increased by inflammatory complications. Andral found an increase in the proportion of blood-corpuscles from 127 to 136 parts in 1000.

The respiratory apparatus, except the Schneiderian membrane, is usually normal when no complications exist. Samuel Fenwick[1] made post-mortem examinations in sixteen cases of scarlet fever, and concludes from them that inflammation of the mucous membrane of the stomach and intestines occurs like that of the skin, followed by desquamation of the epithelial cells, like that of the epidermis. I have had the opportunity of examining the stomach and intestines of those who died of scarlet fever in the eruptive stage, and have not found any unusual hyperæmia of the gastro-intestinal surface, except when gastro-intestinal inflammation, usually indicated by diarrhœa, had occurred as a complication.

In some cases the abdominal organs exhibit changes which suggest a resemblance to typhoid fever. The spleen is enlarged and somewhat softened, and Peyer's patches and the solitary glands are thickened and prominent, but less in degree than in typhoid fever. The mesenteric glands also are in a state of hyperplasia. In other patients these parts appear normal.

Klein made microscopic examination of the liver in eight cases, and states that he found granular opaque swelling of liver-cells, and changes in the internal and middle coats of certain arteries similar to those observed in the kidneys, which have been described above. He also found evidences of interstitial inflammation, as an increase of round cells and connective tissue in the liver. He remarks also that he observed hyaline degeneration of the intima of arteries in the spleen. Rilliet and Barthez state that swelling and softening of the spleen are exceptional in scarlet fever, but are sufficiently common to merit attention. In post-mortem examinations which I have witnessed nothing noteworthy has appeared to the naked eye in the state of the liver, nor ordinarily in that of the spleen.

The efflorescence, though one of the anatomical characters, has perhaps been sufficiently described in the foregoing pages. It begins over the neck, chest, and groins as numerous reddish points not larger than a pin's head, closely crowded together, but with skin of normal color between. It is estimated that the aggregate efflorescence and aggregate normal skin over a given area are about equal. If the cutaneous circulation be active and the febrile movement be considerable these spots extend and coalesce, producing an efflorescence like erythema or like the hue of a boiled lobster, to which it has been likened. The efflorescence, less upon the face than upon the trunk, contrasts in this respect with that of measles, in which the rash is full in the face, often causing some swelling of the features. It is also less upon the palmar and plantar surfaces than elsewhere. It scarcely causes any perceptible elevation of the skin, but in certain localities, as upon the backs of the hands and upon the forearms, it communicates the sensation of slight roughness. The seat of the efflorescence is mainly in the superficial layers of the skin, but it is said that it sometimes has occurred upon a cicatrix, as that from a burn. In the robust and in favorable cases in which the circulation is active the rash has a scarlet hue, and when the cutaneous capillaries are emptied, and the skin rendered pale by pressure with the

[1] London Lancet, July 23, 1864.

fingers, the circulation immediately returns when the pressure is removed. In malignant cases the color is not scarlet, but dusky red, and so sluggish is the capillary circulation that the skin when pressed upon recovers the blood very slowly. In grave cases also extravasation of blood in minute points or transudation of its coloring matter is apt to occur in portions of the surface, when, of course, decolorization is not fully produced by pressure. In cases ending fatally, during the eruptive stage the efflorescence may entirely disappear in the cadaver, or it remains upon parts of the surface, especially depending portions. Desquamation is attributable to the exaggerated proliferation of the epidermis and the loosening of its attachment by the inflammation.

Diagnosis.—In the commencement of scarlet fever, prior to the eruption, no symptoms or appearances exist which enable us to make a positive diagnosis. Positive statement in reference to the nature of the attack should be deferred, for the credit of the physician. Still, if a child with no appreciable local disease sufficient to cause the symptoms a few days after exposure to scarlet fever, or during an epidemic of this malady, be suddenly seized with fever, the pulse rising to 110, 120, or more, and the temperature to 102°, 103°, or 105°, scarlatina should be suspected. The diagnosis is rendered more certain at this early stage if vomiting occur, and especially if the fauces be red, for hyperæmia of the fauces, due to commencing pharyngitis, is one of the earliest and most constant of the local manifestations of scarlatina.

When the eruption has appeared, the nature of the malady is in most instances apparent. The punctate character of the eruption before it becomes confluent, its occurrence within twenty-four hours after the fever begins over almost the entire surface, but its absence or scantiness upon the face, and especially around the mouth, serve to distinguish it from other diseases.

Scarlet fever and measles were long considered identical by the profession, and, though the ordinary forms of these maladies can be readily distinguished from each other, cases occur in which the differential diagnosis is attended by some difficulty. But there are differences in the symptoms and course of the two diseases which aid in discriminating one from the other. Measles begins with marked catarrhal symptoms, as if from a severe cold. Mild conjunctivitis, causing weak and watery eyes, coryza, and mild laryngo-bronchitis, with accompanying cough, precede the eruption three or four days and continue during the eruptive stage. The febrile movement in the prodromic stage of measles is remittent, the evening temperature being two or three degrees higher than that in the morning. Contrast this with the invasion of scarlet fever, in which the only catarrh is that of the buccal and faucial surfaces, and there is consequently little or no cough, and the febrile movement, ordinarily high in the beginning, is nearly uniform in the different hours of the day. The scarlatinous eruption appears, as we have seen, within twelve to twenty-four hours about the neck and upper part of the chest, and spreads over the body in a shorter time than that of measles, which appears on the third day. The rash of measles begins to fade at the close of the third or in the fourth day after its appearance, that of scarlet fever not till from the sixth to the eighth day. In nearly all cases of measles, even when the rash is confluent

upon the face and a considerable part of the trunk, in consequence of the high febrile movement and vigorous cutaneous circulation, we observe the characteristic rubeolar eruption upon certain parts of the surface, as the extremities, which, in connection with the history, renders diagnosis certain.

Erythema resembles the scarlatinous eruption, but its duration is commonly shorter. It is limited to a part of the surface, and it is accompanied by much less febrile movement. The temperature in erythema does not usually rise above 100°, unless for a few hours, whereas in scarlet fever it continues considerably above 100° for several days. The scarlatinous efflorescence has also a brighter red or more scarlet hue than that of erythema, except in the more malignant cases, in which the severity of the symptoms renders the diagnosis clear. But an important aid in differentiating the one from the other of these diseases is the fact that in erythema there is, with few exceptions, no faucial inflammation, and in the few instances in which it is present it is slight and transient, fading within a day or two.

Scarlet fever is readily diagnosticated from diphtheria, although the affinity is close between these two maladies. The early appearance of the pseudo-membrane upon the fauces in diphtheria, its absence in scarlet fever, and the absence of any appearance resembling it until the fever has continued some days, and the characteristic efflorescence upon the skin in scarlet fever, render diagnosis easy. If scarlet fever have continued some days when first seen by the physician, the diphtheritic pseudo-membrane may be present as a complication, or the fauces may present an appearance like diphtheria from ulceration or sloughing and the presence of foul and offensive secretions, which produce a dark-grayish and fetid mass over the faucial surface. Under such circumstances the character of the disease is ascertained by the history of the case, and especially by the occurrence of the scarlatinous eruption. An erythema transient and limited to a part of the surface sometimes appears in the commencement of diphtheria, and at a later period, as a result of the toxæmia, upon the extremities. Roseoloid points and patches often occur upon the extremities. Both kinds of rash can be readily diagnosticated from that of scarlet fever, for the erythema, as has been stated, is transient and partial, and does not exhibit minute points of deeper injection, while the toxæmic rash differs in form and aspect from that of scarlet fever, and appears at a stage when the scarlatinous efflorescence has faded or begun to fade.

The efflorescence of rötheln sometimes closely resembles that of scarlet fever, though it is usually more like that of measles; but it is ordinarily accompanied by symptoms which are much milder than those of scarlet fever, and it begins to abate as early as the third, and disappears on the fourth day. The eyes have a suffused appearance, the temperature may reach 102° or 103°, and the efflorescence may be as general over the body as that of scarlet fever, but there is not the aspect of serious indisposition, and the speedy abatement of the symptoms shows that the disease is not scarlet fever.

PROGNOSIS.—The prognosis depends on the form of scarlet fever, whether mild or severe, the strength of the patient, and the presence

or absence of complications or sequelæ. The type of the disease is sometimes so mild throughout an epidemic or during a series of years that death seldom occurs, whatever the mode of treatment; but afterward the type changes, and the percentage of deaths increases and remains high till another mitigation in the type occurs.

Sydenham, in the middle of the seventeenth century, stated that scarlet fever, as he saw it in London, was so mild that it scarcely deserved the name of disease: "Vix nomen morbi merebatur." Morton some years later, and Huxham in the following century, had abundant reason to regret the change of type, and now throughout Great Britain scarlet fever is one of the most fatal and most dreaded of the diseases of childhood. In Dublin during the present century, prior to 1834, scarlet fever was uniformly mild, so that on one occasion of eighty patients in an institution all recovered. In 1834 the type of the disease totally changed and epidemics of unusual virulence occurred. The type frequently changes from mild to severe or severe to mild, not only in consecutive years, but in consecutive months. A few years since a distinguished physician of New York treated about fifty cases of scarlet fever in one of the institutions without a single death, but a few months later the type of the malady changed, and his own son was among those who perished from it. The prevailing type of the disease should therefore be considered in giving the prognosis when in the commencement of a case we are asked the probability as regards the termination.

Extensive statistics, including those collected by Murchison from various sources, show that in different epidemics the mortality may vary as much as from 3 per cent. (Eulenberg, of Coblentz) to 19.3 per cent. (cases seen by myself in New York City in 1881–82, many of which were complicated by diphtheria), or even to 34 per cent. (epidemic in the Palatinate in 1868–89). The hospital statistics of Rilliet and Barthez gave 46 deaths in 87 cases, or about 53 per cent.

Observations have thus far failed to establish any connection in the atmospheric conditions of temperature or moisture and the type of scarlet fever. Grave as well as mild epidemics have occurred in all climates and seasons.

The mortality is nearly equal in the two sexes, but age has a marked influence on the percentage of deaths. Comparatively few contract scarlet fever under the age of one year, and the period of its greatest mortality, and also of its greatest frequency, is between the ages of one and six years. The following are statistics bearing on the relation of the age to the percentage of deaths:

		Under 1 year.	From the close of 1st till close of 5th year.	From the 5th to the 12th year.	
Fleishman,	Cases	8	204	260	
	Deaths	6	88	51	
			1st to close of 6th year.	6th to 12th year.	From the 12th to 20th year.
Kraus,	Cases	13	113	106	40
	Deaths	4	29	10	2
				7th to 16th year.	
Voit,	Cases	5	166	109	
	Deaths	1	24	10	

		Under 1 year.	From 1st to close of 5th year.	Over 5 years.
Röset,	Cases	43	156	88
	Deaths	16	31	3

		Under 5 years	5th to 10th year.	10th to 15th year.	Over 15 years.
Russiger,	Cases	101	126	47	27
	Deaths	21	20	3	0

These statistics, which I believe correspond with the observations of others, show that although few cases occur in the first year, the percentage of deaths is large, and that a majority of the total deaths from this malady occur under the age of six years. After the sixth year the greater the age the less the proportionate number of deaths.

Scarlet fever is liable to so many complications and sequelæ that a physician should not predict a certain favorable termination in the beginning, however mild and regular the symptoms may be. But a favorable result may be expected if the attack be mild, the efflorescence appear at the proper time and extend over the entire surface, the angina be moderate and accompanied by little or no cellulitis or adenitis, with pulse under 140, temperature not above 103°, and no marked nervous symptoms.

Whether the complications or sequelæ be dangerous depends upon their character. Rheumatism has never in my practice been dangerous, nor has it materially retarded convalescence, except when it affected the heart, causing pericarditis or endocarditis, when it involves great danger. Nephritis, if it be moderate, attended by little albuminuria and serous effusion, and by the occurrence of few renal casts in the urine, commonly ends favorably under judicious treatment, as we have already stated; but severe nephritis, with abundant albuminuria and casts and serous effusions, soon gives rise to alarming symptoms, and is the cause of death in a considerable number of instances. A similar remark is applicable to the angina, which occurs in all grades of severity. If it be attended by much cellulitis, with considerable ulceration or necrosis, the state is one of danger, in consequence of the difficulty in administering sufficient nutriment, as well as from the diminished assimilation and the loss of strength due to the prolonged inflammatory fever, the septic poisoning, and the occasional hemorrhages. Complication by pharyngeal or nasal diphtheria, now so common where diphtheria is endemic, also greatly increases the danger.

Many cases, even when their course is normal and without complications, involve danger, and some are necessarily fatal, from the direct effect of scarlatinous blood-poisoning. Such are grave or malignant forms of the disease which the experienced eye recognizes at a glance. Death often occurs rapidly from the toxæmia. Such cases are characterized by high temperature (105° or 106°), rapid pulse, dusky-red hue of the surface from languid capillary circulation, pungent heat, frequent vomiting, diarrhœal stools, a dry-brown tongue, and marked nervous symptoms, such as delirium, great restlessness, or stupor. Not a few in this form of scarlet fever take eclampsia, which is apt to be severe and repeated, and to end in fatal coma.

Other inflammatory complications and sequelæ, which have been

described in the preceding pages, retard convalescence and jeopardize the life of the patient, such as empyema, endocarditis, pericarditis, and pneumonia. Otitis media is seldom immediately dangerous, although it may be painful and involve serious consequences, even a fatal meningitis, as has been stated above, after months or years of otorrhœa. Anomalous cases are believed to be, as a rule, more dangerous than such as are attended by an early and full efflorescence and have the usual symptoms.

Treatment. Prophylaxis.—Since the discovery by Jenner of the prophylactic power of vaccination as regards smallpox, the attention of the profession has been frequently directed to the prevention of scarlet fever. Belladonna has been employed for this purpose by a class of practitioners who believe in the theory that an agent which produces symptoms similar to those of a disease is antagonistic to that disease, and therefore tends to prevent it, or, if it be present, to render it milder; and since this herb causes an efflorescence upon the skin and redness of the fauces, it was selected as the proper preventive and remedial agent for scarlet fever. Its use, however, for this purpose has been fruitless, and it is now nearly or quite discarded.

It is probable, from a considerable number of observations, that scarlet fever occasionally occurs in the domestic animals during epidemics of the disease in children. It is stated that Spinola observed it in the horse; that Heim saw a dog that occupied the same bed with a scarlatinous patient sicken with fever, which was followed by desquamation; that Letheby saw scarlatina in swine, and Kraus in young cattle. Prominent veterinary surgeons, as Williams, of Great Britain, admit the occurrence of scarlatina in animals, and the hope has arisen that since smallpox is modified in cattle so as to afford us the vaccine virus, perhaps scarlet fever may also be modified by passing through one of the lower animals, so that a milder and less fatal form of the disease might be produced in man by inoculation from the animal. This theory, though it deserves investigation, is far from being established. It has not yet, so far as I am aware, been shown that scarlet fever is milder in any animal than in man, nor, if we admit that it is modified in the animal, is it certain that the disease could be returned to man in the modified form. In the *N. Y. Medical Record* for March 24, 1883, some experiments are detailed by S. W. Strickler of Orange, New Jersey. He cites the experiments of Caze and Feltz, who injected scarlatinal blood under the skin of sixty-six rabbits, and of these sixty-two died within eighteen hours to fourteen days, which indicated a highly poisonous state of the blood employed, either septic or scarlatinous, and certainly no mitigation of the virulence of the scarlet fever. Strickler obtained from Williams, of Edinburgh, nasal mucus from a horse supposed to have scarlatina, and with it inoculated twelve children, all of whom had sores at the point of inoculation, with redness of the skin around the sores, and in some instances swelling of the adjacent lymphatic glands. It is stated that the children thus inoculated did not contract scarlet fever subsequently when they were exposed to it. Obviously, there is a serious objection to such experiments upon children, so that they may not be repeated, but a movement has been made in one of the New York medical societies looking to the appoint-

ment of a competent committee to investigate them. Some of the prominent veterinary surgeons of this city do not attach much importance to the experiments thus far made, since they are in doubt whether the virus employed was that of the genuine disease.

It is a matter of great interest and importance, and one not yet elucidated, whether or to what extent disinfectant and antiseptic remedies administered internally, prevent the occurrence of the infectious maladies in those who have been exposed, and aid in curing those who are sick with them. Sodium sulpho-carbolate, from which, by decomposition in the system, carbolic acid is supposed to be set free, has been used for this purpose. It is administered to adults in doses of ten to thirty grains, and to children in doses proportionate to their age. Declat has prepared a syrup of phenic (carbolic) acid as a preventive and curative agent in the infectious diseases. It is now employed by several of the New York physicians, but thus far the statistics of its use are not sufficient to determine its efficacy. It is a question whether the so-called antiseptics can, on account of their toxic properties, be used with safety in doses sufficiently large to be antidotal to the specific principle of any of the infectious maladies.

It is not my intention to recommend in this treatise any remedial agent that has not been fully tried and its efficacy determined; but from observations made by myself in nearly twenty families in which scarlet fever was prevailing, I am convinced that boracic acid (acidum boricum), an antiseptic recently introduced into our Pharmacopœia, deserves trial as a preventive and antidote of scarlet fever as well as diphtheria. The good result in my practice from the use of this agent, which only extends over about six months, may be due to the present type of scarlet fever, but I have been surprised at the favorable progress of the cases which appeared very grave in the beginning, at the small mortality, and at the large proportion of well children exposed to scarlatinous cases that escaped infection, to whom this medicine was regularly administered. Boric (boracic) acid has been recently used by aurists with remarkable success in suppurating and granulating otitis media, and by oculists as an eye-wash. E. R. Squibb says of it (*Ephemeris*, May, 1883): "A solution saturated at ordinary temperatures contains between 4 and 5 per cent. . . . . It is a very bland and soothing application, whether applied in powder or solution, relieving irritation and reducing suppuration. . . . . It has been administered internally in large doses without any disturbing effect. The preparation which I have employed is one found in the shops, with the name listerine, prepared by a Western pharmaceutical firm. It contains, according to the manufacturers, the "essential antiseptic constituents of thyme, eucalyptus, baptisia, gaultheria, and mentha arvensis," and also two grains of benzo-boracic acid in each drachm. The dose of listerine which I have employed for an adult is one teaspoonful, considerably diluted with cold water. A child of five years can take ten to fifteen drops every two to four hours. I call the attention of the profession to the use of boracic acid as an antidote to the scarlatinous poison, without sufficient experience to enable me to speak positively of its efficacy, but with the hope and expectation, from observing its

apparent effects in seventeen families afflicted with scarlet fever, that it will be found a useful addition to our means of controlling this much-dreaded and fatal malady.

In the present state of our knowledge the most reliable and certain prophylaxis is the isolation of patient and nurses, and the thorough and judicious employment of disinfectants upon their persons and in the apartments. All furniture and articles not absolutely required should be removed from the sick-room, and no one should be allowed to enter it except the medical attendant and nurses. Constant ventilation should be insisted on by lowering the upper and raising the lower sash of the window two or three inches in mild weather. Even in stormy weather sufficient ventilation can be obtained in this way without exposing the patient to currents of air, which should be avoided.

Since the exhalations from the body, the various excretions, and the epidermic cells shed so abundantly in the desquamative period contain the scarlatinous poison, measures should be employed to disinfect them, in so far as the comfort and well-being of the patient will allow. Vessels which receive the excretions should contain carbolic acid, chloride of lime, or other disinfectant, and they should be immediately emptied and cleaned after use. By the frequent application of disinfecting washes to the nostrils and fauces the secretions from these surfaces are to a great extent deprived of their contagiousness. If otorrhœa occur, boracic acid, so serviceable in its treatment, acts as a disinfectant, but in addition the ear should be syringed with warm carbolized water, one drachm of carbolic acid to the pint of water, and this should be continued during convalescence, for cases occur which show that the discharge from the ear is probably the vehicle by which the virus is communicated. Even as late as the fourth week after the disappearance of the rash children in scarlet fever experience relief from inunction of the surface, and if carbolic acid be added to the substance which is employed for this purpose, and the inunction be made twice daily over the entire surface, contamination of the air through the exfoliations and exhalations from the skin is in great part prevented. The late William Budd, of Bristol, England, was in the habit of recommending inunction of the surface twice daily with sweet oil, which answered the purpose of preventing dissemination of epidermic particles through the air: and we will presently see how successful were his precautionary measures.

A convalescent child should not be allowed to mingle with other children till three or four weeks have elapsed and desquamation has ceased; and all who are liable to take the malady should be excluded from the room in which a case has occurred for a longer period, and until it has been thoroughly disinfected by burning sulphur or other methods.

The New York Board of Health enforces the following excellent regulations to prevent the spread of scarlet fever as well as other acute infectious maladies:

"Care of Patients.—The patient should be placed in a separate room, and no person except the physician, nurse, or mother allowed to enter the room or to touch the bedding or clothing used in the sick-room until they have been thoroughly disinfected.

"Infected Articles.—All clothing, bedding, or other articles not absolutely necessary for the use of the patient should be removed from the sick-room. Articles used about the patients, such as sheets, pillow-cases, blankets, or clothes, must not be removed from the sick-room until they have been disinfected by placing them in a tub with the following disinfecting fluid; eight ounces of sulphate of zinc, one ounce of carbolic acid, three gallons of water. They should be soaked in this fluid for at least an hour, and then placed in boiling water for washing.

"A piece of muslin one foot square should be dipped in the same solution and suspended in the sick-room constantly, and the same should be done in the hallway adjoining the sick-room.

"All vessels used for receiving the discharges of patients should have some of the same disinfecting fluid constantly therein, and immediately after being used by the patient, should be emptied and cleansed with boiling water. Water-closets and privies should also be disinfected daily with the same fluid or a solution of chloride of iron, one pound to a gallon of water, adding one or two ounces of carbolic acid.

"All straw beds should be burned.

"It is advised not to use handkerchiefs about the patient, but rather soft rags, for cleansing the nostrils and mouth, which should be immediately thereafter burned.

"The ceilings and side-walls of a sick-room after removal of the patient should be thoroughly cleaned and lime-washed, and the woodwork and floor thoroughly scrubbed with soap and water."

By such measures of prevention there can be no doubt that the number of cases of scarlet fever would be greatly reduced.

Budd for years recommended similar precautions in the families which he attended, and the following is his testimony in regard to the result: "The success of this method in my own hands has been very remarkable. For a period of nearly twenty years, during which I have employed it in a very wide field, I have never known the disease to spread beyond the sick-room in a single instance, and in very few instances within it. Time after time I have treated this fever in houses crowded from attic to basement with children and others, who have nevertheless escaped infection. The two elements in the method are separation on the one hand, and disinfection on the other."[1]

Hygienic Treatment.—The room occupied by a scarlatinous patient should be commodious and sufficiently ventilated. Its temperature should be uniform at about 70° during the course of the fever. When the fever begins to abate and desquamation commences, a temperature of 72° to 75° is preferable, so that there is less danger that the surface may be chilled during unguarded moments, as at night, when the body may be accidentally uncovered, since sudden cooling of the surface at this time may cause nephritis or some other dangerous inflammation. Henoch does not believe in the theory that the nephritis is commonly produced by catching cold, but many observations show that those who are carefully protected from vicissitudes of temperature, who remain during convalescence in a warm room, and are protected by abundant

[1] British Medical Journal, January 9, 1869.

clothing, more frequently escape this complication than such as are under no restraint of this kind and are carelessly exposed in times of changeable weather. Nevertheless, it is true that a certain proportion suffer from nephritis however judicious the after-treatment may be. The best hygienic management does not always prevent its occurrence. The patient should not, therefore, leave the house until four weeks after the beginning of the fever, and in inclement weather not till a longer time has elapsed. So long as desquamation is going on and the skin has not regained its normal function, the patient should remain indoor, and when finally he is allowed to leave the house he should be warmly clothed.

Therapeutic Treatment.—In order to treat scarlet fever successfully, it is necessary to bear in mind that it is a self-limited disease, running for a certain time and through certain stages, and that it is not abbreviated by any known treatment. Therapeutic measures can only moderate its symptoms and render it milder. The severity of the disease is indicated by its symptoms, and the symptoms are to a certain extent under our control.

Mild Cases.—A patient with a temperature under 103°, and with only a moderate angina, does not require active treatment, but, however light the disease, he should always be in bed and in a room of uniform temperature, as stated above. Instances have come to my notice in the poor families of New York in which scarlet fever was not diagnosticated, and the patients were allowed to go about the house, and even in the open air, in the eruptive stage, till some severe complication or an aggravation of the type created alarm and medical advice was sought, when it appeared that a grave and dangerous condition had, through carelessness and ignorance, resulted from a mild and favorable form of the malady. The physician, when summoned to a case however mild, should never fail to take the temperature, note the pulse, inspect the fauces, and inquire in reference to the fecal and urinary evacuations, that he may detect early any unfavorable changes which may occur.

Since in all cases angina and more or less blood-deterioration are present, the following prescription will be found useful in mild as well as severe scarlet fever:

℞.—Potass. chlorat. . . . . ʒij.
Tr. ferri chloridi . . . . . fʒij.
Syrupi . . . . . fʒiv.—Misce.

Sig.—Half a teaspoonful every hour to two hours to a child of three years; a teaspoonful to a child of six years.

Small doses of this medicine frequently administered act beneficially on the surface of the throat and tend to prevent the anæmia which is so common after scarlet fever. If the medicine be given gradually diluted with only a moderate amount of water, the effect is better on the inflamed fauces. Potassium chlorate is known to be an irritant to the kidneys in large doses, causing intense hyperæmia of these organs, with bloody urine or suppression of urine. The melancholy fate of Fountaine, who died from the effects of one ounce of this medicine, is known to the profession. I have seen a similar instance in a child.

But doses of one to four grains, according to the age, can be administered with safety to children, so that half a drachm to a drachm and a half are taken in twenty-four hours. A quantity much exceeding this amount involves risk. In mild cases it is not necessary to treat the throat by topical measures, the above prescription producing sufficient local effect, but camphorated oil may be used externally. I ordinarily prescribe quinine in small doses for this form of scarlatina, as in the following formula:

℞.—Quiniæ sulphat. . . . . gr. xvj.
Ext. glycyrrhizæ . . . . . ℈ss.
Syr. pruni virginianæ . . . . . f℥ij.—Misce.

Sig.—One teaspoonful every fourth hour to a child of three to five years, the potassium chlorate and iron mixture being administered twice between.

The treatment of scarlatina by antiseptic remedies will be considered hereafter.

The itching and dryness of the surface, which increase the discomfort of the patient in mild as well as severe scarlatina, are relieved by frequently anointing the whole body with vaseline, cold cream, or butter of cocoa. Carbolic acid is an efficient remedy for pruritus, while it is also a disinfectant. It may be used in the following formula:

℞.—Acidi carbolici. . . . . ℥j.
Vaseline . . . . . ℥iv.—Misce.

Sig.—To be applied over the entire surface.

In New York leaf lard has long been employed as an unguent over the entire surface in scarlet fever, and patients experience benefit from it. Alcohol and water or vinegar and water are sometimes employed for the same purpose. The linen should be changed every day and the bed thoroughly aired.

Ordinary Cases and Cases of Severe Type.—A safe temperature in scarlet fever may be considered at or below 103°. If it rise above this, measures designed to abstract heat are very important—more important even in many cases than the medicinal agents which are commonly used to combat this disease. Since a high temperature retards assimilation, promotes deleterious tissue change, and causes rapid emaciation and loss of strength, measures designed to reduce it are urgently needed. "The production of heat depends chiefly on oxidation of the constitutents of the body" (Billroth). Therefore fever indicates an increase of the oxidation and a molecular disintegration above the healthy standard. Hence, the augmentation of urea in the urine and the progressive emaciation and loss of weight which characterize the febrile state. Fever also diminishes the secretions by which food is digested and destroys the appetite, so that repair of the waste is insufficient. Moreover, a high temperature continuing for a time tends to produce degenerative changes, albuminous and fatty, in the tissues, the more rapidly the higher the temperature, so that the functions of organs are seriously impaired. Among the most dangerous of the tissue-changes is granulo-fatty degeneration of the muscular fibres of the heart. In dogs and rabbits that have perished from a high tempera-

ture artificially produced by experimenters granular clouding of the elementary tissues has been found after death.[1] A high temperature, therefore, in itself involves danger, and if it occur in an ataxic disease like scarlet fever, and be protracted, it greatly diminishes the chances of a favorable issue.

The temperature can be reduced without shock or injury to the child by the judicious use of cold water externally. The cold water treatment is not necessary if the temperature be under 103°, though useful if judiciously employed by sponging when the temperature is at 102° or 103°; but if it rise above 103° it is required, and the more urgently the higher the temperature. The external use of cold water as an antipyretic in the febrile diseases is now most universally recommended by physicians, but it still meets with opposition on the part of families, especially in the treatment of the exanthematic fevers, and the directions for its employment are therefore not apt to be fully carried out during the absence of the medical attendant. The old theory that the fevers require warmth and sweating has such a firm hold on the popular mind that some years longer will be required for its removal.

The modes of applying cold water recommended by cautious and experienced physicians are various. Von Ziemssen recommended that the patient be immersed in water at a temperature of 90°, and cool water be gradually added till the temperature fall to 77°. In a few minutes the patient is returned to his bed, his surface dried, and he is covered by the proper bedclothes, when his temperature will probably be found reduced two or two and a half degrees. If the patient complain of chilliness or his pulse be feeble, he should be immediately removed from the bath and stimulants administered, either whiskey or brandy, for if the extremities remain cool and the capillary circulation sluggish, the effect may be injurious, since some internal inflammation may arise to complicate the fever. Under such circumstances increased alcoholic stimulation is required.

The cold pack is also effectual for reducing the temperature. The patient is placed upon a mattrass protected by oil cloth, and is covered by a sheet wrung out of water at a temperature of 70°. This is covered by one or two blankets. In half an hour he is returned to bed, and will be found to have a temperature two or three degrees less than that before the bath. Another method is to apply the sheet wrung out of water at 90°, and then reduce the temperature by adding water at a lower degree from a sprinkler. In most cases, however, I prefer to reduce the temperature by the constant application to the head of an India-rubber bag containing ice. The bags should be about one-third filled, so that it should fit over the head like a cap. At the same time, as a potent means of abstracting heat, at least when the temperature is at or above 104°, a similar application should be made by an elongated rubber bag lying over the neck and extending from ear to ear. Cold applied over the great vessels of the neck promptly abstracts heat from the blood, while it diminishes the pharyngitis, adenitis, and cellulitis; which is an impor-

[1] See experiments by Mr. J. W. Legg, Lond. Path. Soc. Trans., vol. xxiv., and others.

tant gain. At the same time, it is proper to sponge frequently the hands and arms with cool water. If the temperature with this treatment be not sufficiently reduced, one or two thicknesses of muslin frequently wrung out of ice-water should be placed along the arms and upon either side of the face. By such local measures, which are agreeable to the patient and without any shock or perturbing effect on the system, we can reduce the temperature two or three degrees. By adding alcohol or one of the alcoholic compounds to the water the popular objection to the use of cold is overcome.

Trousseau, in the treatment of sthenic cases attended by a high temperature, was in the habit of placing the patient naked in a bath-tub, and directing three or four pailfuls of water to be thrown over him in a space of time varying from one quarter of a minute to one minute, after which he was returned to bed and covered by the bedclothes without being dried. Reaction immediately occurred, often with more or less perspiration. This treatment was repeated once or twice daily, according to the gravity of the symptoms. Trousseau, alluding to this treatment, says: "I have never administered it without deriving some benefit." But the application of cold water in a manner that does not excite or frighten the patient seems preferable. Henoch, having a large experience, gives the following advice in reference to the water treatment: "If the fever continue high and the apparently malignant symptoms described above develop, the head should be covered with an ice-bag, ... and the child placed in a lukewarm bath, not under 25° R. (88.25°F.). I decidedly oppose cooler baths, because in scarlatina, which presents a tendency to heart-failure, cold may produce an unexpected rapid collapse more than in any other affection. But I strongly recommend washing the entire body every three hours with a sponge dipped in cool water and vinegar."[1] In grave cases with a high temperature the application of cold should be sufficient to produce a decided reduction of heat, otherwise the full benefit from its use is not obtained. With proper stimulation and proper precautions prostration does not occur from the ice-bags to the head and neck and cool sponging of other parts, so long as the temperature does not fall below 102° or 103°. The danger alluded to by Henoch can only occur from the use of the pack or general bath, and the water treatment can be efficiently carried out and the temperature sufficiently reduced without resorting to these. Even Currie, of Edinburgh, who first drew attention to the benefit from the cold water treatment of scarlet fever in an age when the sweating treatment, and even the exclusion of cool and fresh air from the apartment, were deemed necessary, recommended cold effusion only in sthenic cases with full and strong pulse, and he mentions as a warning two cases with quick and feeble pulse and cool extremities in which death occurred immediately after the use of the water.

Sodium salicylate is in some instances a useful remedy for the reduction of heat in the infectious diseases. It seems to be more decidedly antipyretic than quinine in the febrile and inflammatory diseases, though somewhat depressing to the heart's action. James Couldrey writes to

[1] Diseases of Children.

the *London Lancet* (Dec. 1882, p. 1064) that he has derived great benefit from its use in seven cases of scarlet fever. He administered it every two hours till ringing in the ears was produced, and afterward every four hours, prescribing one grain for each year in the age of the patient. It is, in my opinion, a proper remedy when the pulse is full and strong and the temperature is not sufficiently reduced by the cold water treatment.

Aconite and veratrum viride reduce fever, but they are too depressing to be safely employed in grave scarlet fever, and their antipyretic effect is less than that of water. The use of digitalis might be suggested by the quick and feeble pulse in certain cases that are attended by high temperature, but the judgment of the profession is for the most part against its use in such cases. What Stillé and Maisch state of its employment in typhoid fever appears equally applicable to scarlet fever: "Even its advocates have not shown that it abridges the disease or lessens its mortality, while it is abundantly demonstrated to impair the digestion, reduce the strength, and even to occasion sudden death. The use of digitalis in other forms of fever is equally unsatisfactory, and justifies the judgment of Traube, that the true field of action for digitalis is not fever."

Quinine is the medicine which above all others has been heretofore most used, by almost common consent of the profession, to reduce the temperature in malignant scarlet fever, but its use for this purpose is, according to my observations, far from satisfactory. To obtain its antipyretic action it must be administered in large doses, and if any of the quinine salts in ordinary use be administered by the mouth in sufficient quantity, they are apt to be vomited. To a child of five years five grains should be administered twice daily by the mouth, or ten grains of a soluble salt, as the bisulphate, may be given per rectum, dissolved in a little warm water. Administered per rectum, it is frequently not retained unless held for a time by a napkin. A considerable proportion of the malignant cases are attended by not only irritability of the stomach, already alluded to, but by diarrhœa, so that quinine, if administered at all, should be employed hypodermically. The double salt of quinia and urea answers for this purpose, as it is very soluble in water and does not produce inflammation of the connective tissue. When the antipyretic doses of quinine are discontinued, this agent may be prescribed as a tonic in the doses recommended for the treatment of mild scarlet fever.

In severe cases with frequent and rapid pulse in which ante-mortem heart-clots are apt to occur, the ammonium carbonate is often useful. It should be dissolved in water and given in milk, in as large doses as five grains every hour or second hour to a child of five years. It aids in producing stronger contraction of the cardiac muscular fibres, and thus diminishes the danger of the formation of thrombi. Ten-drop doses of the aromatic spirits of ammonia may be employed instead of the carbonate, given in sweetened water. It is especially useful if the stomach be irritable.

In severe cases attended by considerable angina and foul and offensive secretions upon the faucial surface an antiseptic, as boracic acid in small

quantity, should be added to the potash and iron mixture recommended above. If no drink be allowed for a few minutes after the dose, so as not to wash it too soon from the fauces, the antiseptic effect is more certainly produced. Those old enough should be directed to hold the medicine for a moment like a gargle in the throat before swallowing it. I employ boracic acid by preference, as in the following formula:

℞.—Acid. boracic. . . . . ℥ss.
Potass. chlorat. . . . . ℥ij.
Tr. ferri chloridi . . . . . f℥ij.
Glycerinæ, ... } āā f℥j.
Syrupi . . . . . }
Aquæ . . . . . f℥ij.—Misce.

Sig.—Give one teaspoonful every two hours to a child of five years.

More minute directions will presently be given for the treatment of the pharyngitis when we speak of the complications.

Alcohol, whether administered in one of the stronger wines, as sherry, or in whiskey or brandy, is a most useful remedy in scarlet fever, and is indeed indispensable in all grave cases which are attended by feeble capillary circulation and evidences of prostration. Milk is also the best vehicle for this agent. The wine-whey or milk-punch should be given every hour or second hour. In scarlet fever, as well as diphtheria, comparatively large doses are required, as a teaspoonful of the stimulant every hour or second hour for a child of five years.

During convalescence the hygienic treatment already described is important. Nutritious diet and a moderate amount of alcoholic stimulants are required, while the patient is kept indoor and protected from currents of air as long as desquamation is occurring. More or less anæmia is present in most convalescent patients, so that a mild tonic containing iron will aid in restoring the health. Elixir of calisaya-bark and iron; preparations of beef, iron, and wine, or the following prescription, will be found useful under such circumstances:

℞.—Ferri et ammon. citrat.
Ammon. carbonat. . . . . āā ℥ss–℥j.
Syrupi . . . . . f℥j.
Aquæ . . . . . f℥ij.—Misce.

Sig.—Dose, one or two teaspoonfuls, according to the age, in water, every second or third hour.

ANTISEPTIC TREATMENT.—It is still to be determined whether or to what extent antiseptics, administered internally, antagonize and control the scarlatinous poison, and are, therefore, curative of scarlet fever. The most important agent of this class, carbolic acid, can only be employed in small doses, for a dose much exceeding a drop for a child, or even exceeding a fractional part of a drop for a young child, might produce poisonous symptoms. Carbolic acid is a cardiac and arterial sedative, and it appears to reduce temperature. Intrauterine injections of carbolized water in the treatment of puerperal fever are known to reduce temperature, even when there is no septic matter in the uterus to be disinfected and washed away, as in a case related to me in which the

fever proved to be due to measles. It is not improbable that the antipyretic action in patients of this class who have no septic substance within the uterus is due largely, if not mainly, to the absorption of carbolic acid from the uterine surface and its sedative action on the vascular system. Whether this agent, so highly extolled by Declat, and to which I have alluded in a preceding page, can be safely employed in doses large enough to be efficient and curative will be determined by future observations. The same remark is applicable to the sulphocarbolate of sodium, whose antiseptic action is supposed to be due, as already stated, to the liberation of carbolic acid in the system. Since boracic acid does not seem to have any deleterious action, this agent has been administered to most of my scarlatinous patients during the last year, in addition to the older and better known remedies, and with a very small percentage of deaths. What may be the result in a more severe type of the disease remains to be seen.

Treatment of Complications and Sequelæ.—Local measures designed to diminish or cure the pharyngitis are important in all but the mildest cases. They are more especially required in the anginose variety and in those not infrequent cases in which diphtheria complicates scarlatina. Formerly it was necessary, in making applications to the fauces, to employ the brush or probang for those too young to use the gargle, but hand-atomizers, as Richardson's or Delano's, which are now in common use, afford a quick and easy method for making such applications. Six or eight compressions of the bulb of a good atomizer are sufficient to cover the fauces with the spray. Those hand-atomizers in the shops which have slender metallic points are apt to prick the buccal surface and cause bleeding if the child resist and toss the head. To prevent this, I am in the habit of directing India-rubber tubing to be drawn over the point in such a way as not to obstruct its action. The following will be found useful mixtures for the atomizer: For ordinary cases,

℞.—Acidi carbolici ʒss, vel. Acid. boracic. ʒij.
Potass. chlorat. ʒij.
Glycerinæ fʒij.
Aquæ fʒvj.—Misce.

If the surface of the throat be covered by foul secretions,

℞.—Acidi carbolici . . . . ʒss.
Potass. chlorat. . . . . ʒij.
Glycerinæ . . . . . fʒj.
Aquæ calcis . . . . fʒvij.—Misce.

Or else,

℞.—Tinc. ferri chloridi . . . fʒss.
Acidi sulphurosi . . . fʒij.
Potass. chlorat. . . . . ʒij.
Glycerinæ. . . . . fʒj.
Aquæ . . . q.s. ad. fʒvj.—Misce.

If diphtheritic exudation complicate the scarlatinous angina, or the surface of the throat in consequence of ulceration or necrosis present an

appearance like that in diphtheria when the exudation begins to soften, being foul, jagged, of a dirty brown appearance from dead matter and fetid secretions, those mixtures for spraying the throat will be found useful which are recommended in our remarks relating to the local treatment of diphtheria.

The following mixtures are also beneficial for local treatment when the faucial surface is foul and offensive from the exudations and secretions. They should be applied by a large camel's-hair pencil every three to six hours:

℞.—Acidi carbolici . . . . . gtt. x.
Liq. ferri subsulphatis . . . . f℥ij.
Glycerinæ . . . . . f℥j.—Misce.

℞.—Ol. citronelli . . . . . gtt. vj.
Iodoform . . . . . ℥ij.
Vaseline . . . . . ℥ss.—Misce.

In all cases of scarlatinous pharyngitis sufficiently severe to require special treatment, cool applications should be made over the neck from ear to ear, as by two thicknesses of muslin frequently squeezed out of cold water, or by the elongated India-rubber bag already recommended in our remarks relating to methods to reduce temperature.

In the first days of scarlet fever the coryza is slight, and no discharge from the nostrils occurs, so that no local treatment is required; but before the termination of the malady, in cases of ordinary gravity, a nasal discharge usually supervenes, producing more or less redness and excoriating the upper lip. Moreover, in localities where diphtheria occurs, if this malady complicate scarlet fever, it is apt to affect the nostrils at the same time that the fauces are invaded. These conditions require local treatment of the nares. It should be remembered that the Schneiderian membrane is midway in sensitiveness, as it is in location, between the conjunctival and buccal surfaces, and is readily irritated by strong applications. Medicinal applications made to it must be much milder than those which the fauces tolerate. They should always be applied warm, and a teaspoonful of any mixture properly employed is sufficient for each nostril at one sitting. The applications should usually be made every two or four hours, according to the gravity of the case and the amount of discharge. The best instrument for this purpose is a small syringe of glass or brass with curved neck and bulbous tip. The child's head should be thrown back and the piston depressed rapidly, so as thoroughly to wash out the nasal cavity. The application can also be made through an atomizer with a rounded tip or a tip covered by rubber tubing. The following is a useful prescription:

℞.—Acidi carbolici . . . . . ℥ss.
Sodii chloridi . . . . . ℥ij.
Aquæ . . . . . Oj.

The substitution of 2 or 3 drachms of boracic acid in place of the carbolic acid makes a nicer preparation. If the diphtheritic pseudo-membrane appear in the nares, the officinal lime-water, injected every hour or second hour, is beneficial in consequence of its solvent action on pseudo-membranes.

It is evident, from what has been stated above, that the condition of the ear should be closely observed in and after scarlet fever. If the patient have earache, considerable relief may be obtained in the commencement by dropping a few drops of laudanum and sweet oil into the ear and covering it by some hot application, either dry or moist, which will retain the heat. A light bag containing common table-salt, heated, or dry and hot chamomile flowers, will also answer the purpose. Water as hot as can be well tolerated dropped into the ear or allowed to trickle from a fountain syringe, so as to fill the ear, is also very beneficial in allaying the pain. If a few drops of laudanum be added, it is more useful. If the pain be not quickly relieved, a leech should be applied at the base of the tragus. O. D. Pomeroy, an experienced aurist of New York, says: "Leeching employed at the right time rarely fails to subdue the pain and inflammation. The posterior face of the tragus is ordinarily the best place for applying the leech, but it may be applied in front of the ear or behind, wherever the tenderness on pressure is greatest. In my opinion, paracentesis may frequently be rendered unnecessary by the timely use of one or two leeches applied to the meatus."

If the otitis continue, as shown by pain in the ear, of which children old enough to speak bitterly complain, and which causes those too young to speak to press their fingers into or against their ears, this inflammation should not be neglected, as it may involve serious consequences. Multitudes of children have had permanent impairment or even loss of hearing, with caries or necrosis of the walls of the middle ear and of the mastoid cells, which might have been prevented by prompt and skilful management of the ear in the early stage of the inflammation. If, therefore, the otitis continue without mitigation of pain after the above measures have been employed, paracentesis of the drumhead is probably required. The following directions for performing this operation, which will be useful to country practitioners who may not be able to obtain the assistance of a specialist, are from the pen of Pomeroy: "The forehead mirror should be worn, in order to leave the hands free to operate by either artificial or day light. A good-sized speculum is introduced into the meatus. Then an ordinary broad needle, about one line in diameter, with a shank of about two inches, such as oculists use for puncturing the cornea, should be held between the thumb and fingers, lightly pressed, so as not to dull delicate tactile sensibility. The part being well under light, the most bulging portion of the membrane should be lightly and quickly punctured with a very slight amount of force. The posterior and superior portion of the membrane is the most likely to bulge. The chordæ tympani nerve ordinarily lies too high up to be wounded. The ossicles are avoided by selecting a posterior portion of the membrane. After puncture the ear should be inflated by an ear-bag whose nozzle is inserted into a nostril, both nostrils being closed, so as to force the fluid from the tympanum. The puncture may need to be repeated at intervals of a day or two, provided that the pain and bulging return."

Albert H. Buck, of New York, in a highly instructive paper read before the International Medical Congress in 1876, writes as follows of

paracentesis of the membrana tympani in scarlatinous otitis: "In this one slight operation, which in itself is neither dangerous nor very painful, lies the power to prevent the whole train of disagreeable and dangerous symptoms.' Buck relates an instructive example: The age of the patient was three years, and the earache had been complained of only about twenty-four hours. "Toward morning," says he, "I was sent for, as the pain had become constant. . . . . An examination with the speculum and reflected light showed an œdematous and bulging membrana tympani (posterior half), the neighboring parts being very red, though as yet but little swollen. In the most prominent portion of the membrane I made an incision scarcely three millimetres (one-tenth inch) in length, and involving simply the different layers of the membrana tympani. This was almost immediately followed by a watery discharge (without the aid of inflation), which ran down over the child's cheek. At the end of three or four minutes the child had ceased crying, and in less than a quarter of an hour she was fast asleep. At first, the discharge was very abundant and mainly watery in character, but it steadily diminished in quantity and became thicker, till finally, on the fourth day, it ceased altogether. On the tenth day the most careful examination of the ear could not detect any trace of either the inflammation or the artificial opening." The ear had probably been saved from ulceration of the drum membrane, long-continued suppurative otitis, and perhaps permanent impairment of hearing.

When an opening has been made in the membrana tympani either by incision or ulceration, it is advisable in some instances to inflate the tympanum by Politzer's method, which has been alluded to above. The nozzle of an India-rubber bag, with a flexible tube attached, is introduced into the nostril on the affected side, and both nostrils are compressed against it. The patient fills his mouth with water, which he swallows at a given signal, as after the words one, two, three, spoken by the operator. During the act of swallowing, which opens the Eustachian tube, the rubber bag is forcibly compressed, which forces the air along the tube into the middle ear and facilitates the escape of the pent-up secretions in the tympanic cavity.

If the otitis have continued unchecked by treatment until the secretions within it, after days and nights of suffering, have escaped by ulceration through the drumhead, the opportunity for prompt and certain cure is passed. Still, the patient under these circumstances may quickly recover, or there may be the other alternative described above, in which the ear is badly damaged and chronic inflammation established in the walls of the tympanum, giving rise to an offensive otorrhœa. In this state of the ear internal remedies are indicated, such as surgeons employ in suppurative inflammations of bone occurring in other parts of the system. Cod-liver oil and iodide of iron are required, especially by patients of strumous diathesis, the object being to promote a more healthy state of system, so as to prevent extension of the inflammation and facilitate the healing process. Carbolized solutions, as the following, syringed warm into the ear in which otorrhœa is occurring, are useful in promoting cleanliness and increasing the comfort of the patient:

℞.—Acidi carbolici . . . . . ℥ss.
Glycerinæ . . . . . f℥ij.
Aquæ . . . . . f℥iv.—Misce.

But recently a much more effectual curative agent for local treatment has been discovered in boracic acid, by the use of which the discharge more quickly diminishes and the condition of the ear more certainly and rapidly improves than by the use of the carbolized mixtures. When the inflammation is recent and the ear sensitive and painful, the following prescription should be used:

℞.—Acidi boracici . . . . . ℥ijss.
Morphiæ sulphat. . . . . gr. j.
Glycerinæ,
Aquæ . . . . . āā f℥j.—Misce.

Sig.—Drop one to three drops into the ear three times dialy.

If the acute stage of the otitis have passed, with fever and pain, and no tenderness be present on pressure, the following prescription, which causes too much pain in the acute stage, will be found useful to check the inflammation and otorrhœa and restore a healthy state to the granulating surface:

℞.—Acidi boracici . . . . . ℥ijss.
Alcohol.
Aquæ . . . . . āā f℥j.

Sig.—Drop one to three drops into the ear three times daily.

The beneficial effects observed from the use of boracic acid in aural surgery have given it nearly the same position as a curative agent to diseases of the ear which atropine holds to diseases of the eye. Recently, aurists are employing finely triturated powder of boracic acid dusted into the ear. The patient lies upon the side with the affected ear uppermost. The ear is thoroughly cleaned by syringing with tepid water, and by means of a little scoop made of stiff paper or pasteboard or the segment of quill as much of the powder is introduced into the ear as will cover a five-cent silver piece. By working the ear it descends to the drumhead. I can bear witness to its efficacy in the otorrhœa of children when it is used in this manner three times daily.

The following astringent has also been employed with good results for the otorrhœa resulting from scarlet fever as well as from other causes:

℞.—Zinci sulphatis,
Aluminis . . . . . āā gr. v.
Aquæ . . . . . f℥j.—Misce.

A few drops of this should be dropped into the ear, or, if the ear be sensitive and painful, five drops should be added to a teaspoonful of warm water and dropped or syringed into the ear.

But in recent times, aurists have discovered a remedy superior to the above in iodoform, the action of which is safe and efficient for protracted otorrhœa with granulations, and it is superseding to a great extent the agents heretofore used in the treatment of this disease. The ear should first be thoroughly cleaned by syringing with warm water

and dried, and iodoform, to which a little balsam of Peru is added to mask the disagreeable odor, should be pressed down to the bottom of the auditory canal by any convenient instrument. It is anodyne, astringent, and disinfectant, and should be employed in a dry state in considerable quantity.

The sequelæ of otitis media, such as granulations sprouting out from the drumhead, some of which may be of large size, and are known as polypi, may require treatment by the aurist. A polypus may sometimes be removed by the forceps, or better by the snare. Polypi not large and favorably located can sometimes be cured by an astringent powder, as iodoform, sulphate of zinc, or alum, or by applying the liquid subsulphate of iron. The otitis externa produced by the irritating discharge which flows from the middle ear soon disappears when the flow ceases.

The renal affection, which, as we have seen, so often commences in the declining period of scarlet fever, or during convalescence in mild as well as severe cases, is frequently more dangerous than the primary disease. It largely increases the percentage of deaths. A clear appreciation of its therapeutic requirements is important, since by judicious treatment many recover who would inevitably be sacrificed by improper measures. The family should be informed that the danger from scarlet fever does not cease with the decline of the eruption, and that the kidneys may become seriously affected by too early exposure of the patient to currents of air or sudden changes of temperature, by which cutaneous transpiration is checked. He should, therefore, be kept indoor in a comfortable and uniform temperature three or four weeks after the termination of the fever, until desquamation has entirely ceased and the new epiderm is sufficiently thick and firm to protect the surface. During the changeable temperature of the autumnal, winter, and spring months even longer confinement at home may be advisable.

The nephritis and consequent albuminuria antedate by some days the occurrence of dropsy, and a physician should never discharge a scarlatinous patient without one or more examinations of his urine. When his visits cease the nurse should be instructed to make the examinations by heat and nitric acid during the ensuing month, and if any evidence, however slight, appear that the kidneys are involved, he should be notified, in order that appropriate treatment may be immediately commenced. Early and correct treatment of the nephritis is attended by much better results than delayed treatment, and many more patients are doubtless now saved than in former times, when little attention was given to the state of the kidneys until dropsy or other prominent symptoms appeared. I have found no mother or nurse so ignorant that she could not properly employ the test of nitric acid and heat, and if she be solicitous for the welfare of the child, she will not hesitate to carry out the directions and immediately notify the physician if the tests employed produce the least cloudiness or turbidity of the urine.

The patient as soon as nephritis commences, as shown by the state of the urine, should be put to bed in a room of warm and equable temperature (72° to 75° F.). His diet should be liquid, consisting of milk, farinaceous food, and a moderate quantity of animal broths. He may

drink liquids freely, especially water not too cool, to which spiritus ætheris nitrosi is added. If he be prostrated by the primary disease, alcoholic stimulants should be allowed.

The indications are to relieve the hyperæmic kidneys by diaphoresis and purgation. To produce the former the patient should be immersed in a warm bath at about the temperature of the body (98° to 100°), in which, if he be quiet and comfortable, he should remain from fifteen to twenty minutes, but if restless and frightened by the water a less time, after which he should be placed in a warm bed and well covered by blankets. If perspiration result, the bath has been useful, and it may be employed in grave cases two or three times daily. If perspiration do not result, it may be produced by surrounding the body either by hot dry or moist air. Hot dry air may be produced by burning alcohol in a thin layer upon a plate under a chair upon which the patient sits while he is surrounded by a blanket, or he may be covered in bed and the hot air introduced under the bedclothes. In New York a convenient apparatus is used for this purpose, consisting of a small sheet-iron pipe enclosed in a small box of the same material. The box is in the form of a trunk, with a handle for convenience in carrying, and the lower end of the pipe, which extends nearly to the floor, contains an alcohol lamp. Hot moist air may be produced by placing against the patient bottles of hot water surrounded by towels wrung out of water. The steam arising from them and enveloping the body and limbs produces a prompt sudorific effect. There is in use in this city, in the treatment of these and similar cases requiring diaphoresis, a convenient apparatus for generating steam. It consists of a cylinder pierced with holes for the admission of air and containing a spirit lamp, over which is a pan or pail holding a little water. The patient, nearly naked, is placed in a chair with the apparatus underneath, and is covered by a blanket, so that the steam surrounds the body. This gives rise to free perspiration, which continues after the patient is placed in bed. This treatment should be repeated one or more times daily, according to the gravity of the case.

The sudorific effect of the treatment by external warmth described above should be aided by employing diaphoretics. Those which have been most used are the acetates of ammonium and potassium, the bitartrate and citrate of potassium, and spiritus ætheris nitrosi. If employed when the surface is cool, they act rather as diuretics than diaphoretics. These agents, being simple in their action and without deleterious effect, may be given frequently and in large proportionate doses for the age.

But lately a diaphoretic which far surpasses these in efficiency has been discovered in pilocarpine, the active principle of jaborandi. Being soluble in water and tasteless, it is easily administered, and is retained when, on account of the uræmic poisoning present in scarlatinous nephritis, the stomach is irritable and other medicines, as digitalis, are rejected. Ether may be employed with it, or the amount of alcoholic stimulant may be increased at the time of its exhibition in order to guard against any depressing effect. To a child of two years one-fortieth to one-twentieth of a grain may be given every six hours by the mouth. It may also be employed hypodermically, as one-twentieth of a grain to a child of five years. It has both a diaphoretic and diuretic action, while

it stimulates both the salivary and mucous secretions. According to one observer, an adult when fully under the influence of pilocarpine secretes from one pint to one quart of saliva within two hours, and Leyden reports a case of diphtheritic nephritis in which the quantity of urine rose from half a pint to five pints daily. But its most prompt and certain action is upon the sweat-glands. Hirschfelder speaks of its beneficial action in relieving various forms of dropsy, and adds: "In one morbid condition of the kidney, however, jaborandi is the remedy par excellence, and that is the acute parenchymatous nephritis which frequently follows scarlatina. . . . . This disease heals spontaneously if the danger that threatens life from reduction of the urine and from the effusions of fluid into the cavities of the body be averted. In this disease jaborandi works wonders." I have also found it an invaluable agent when the older remedies failed and death seemed imminent. The following cases, in which the beneficial action of this agent was apparent, occurred in my practice:

Case 8.—G——, male, aged five years and six months, sickened with scarlet fever on June 2, 1882. It began with vomiting, and was attended by a degree of febrile movement which indicated an attack of rather more than the average gravity. The fauces at one time exhibited a slight exudation like that of diphtheria. In the declining stage of the malady rheumatic pain and tenderness occurred in the wrist and finger-joints, but not in those of the lower extremities. The case, however, progressed favorably, and during the convalescence my attendance ceased. On June 24th my attention was again called to the child, when the urine was found to be scanty and very albuminous. External measures, such as are described in the foregoing pages, were employed, and the infusion of digitalis with potassium acetate ordered to be given every three hours, but this medicine was for the most part vomited. The bowels were kept open by jalap and the potassium bitartrate. The urine, however, continued scanty, and on June 28th severe convulsions occurred. At this time the quantity of urine was only f℥ij in twenty-four hours. The pulse in the convulsions was quick and feeble, the skin very hot, and the axillary temp. 103°. The eclampsia continued one hour, and was controlled by large and repeated doses of bromide of potassium, aided by clysters of five grains of hydrate of chloral in water. Muriate of pilocarpine was now directed to be given in doses of one-thirty-second of a grain every three hours, dissolved in cold water. This agent was not vomited, and it must have been given by the parents in the fright and anxiety in larger or more frequent doses than were directed, for on July 1st the bottle containing one grain was empty. Free diaphoresis resulted from the pilocarpine, and the quantity of urine was increased. The mother stated that the child had taken only two doses, or one-sixteenth of a grain, of pilocarpine when the diuretic effect was apparent and free diaphoresis also occurred. She also stated subsequently that the quantity of urine was larger when the pilocarpine was administered every third hour than when given at a longer interval. A flaxseed poultice on which mustard was dusted was also applied over the kidneys. On June 20th the pulse was 96, temperature 100.5°; occasional convulsive attacks occurred, which were readily controlled by enemata of hydrate of chloral. On June 30th the symptoms were all better; no more attacks of eclampsia had occurred, and the urine was more abundant and less albuminous.

The mother remarked that the new medicine (pilocarpine) had settled the stomach and increased the urine. The patient continued to improve, and on July 4th the record states: "Now takes the pilocarpine, gr. $\frac{1}{32}$, every six hours; passes urine freely since yesterday; has not vomited since he began to take the pilocarpine; pulse 106, axillary temp. 99°; is playful and takes milk freely, nearly three quarts in twenty-four hours, with some farinaceous food. Digitalis with potassium acetate is also given in occasional doses." July 6th, pulse 92, temp. 99°; perspires much, and urine nearly normal in quantity and character.

Case 9.—Mary S——, aged five years, on Dec. 22, 1882, presented the symptoms of severe nephritis. Her brother had scarlet fever two weeks previously, and she had sore throat at about the same time, but without efflorescence; pulse 98, temperature 98.5°; her urine highly albuminous, and reduced to f℥iv in twenty-four hours; bowels constipated. Ordered a single dose of

℞.—Hydrarg. chlor. mitis . . . . . gr. iij.
Resin. podophylli . . . . . gr. ½.—Misce.

The muriate of pilocarpine was also ordered, gr. $\frac{1}{20}$, but the patient vomited soon after taking it. Another dose was retained, and was followed by considerable perspiration. Dec. 23d, had one stool from the powder of yesterday. Has taken five does of pilocarpine, but vomited after three of them. The last dose was administered at 10 P. M., and the mother says she "sweat fearfully" during the night. The patient was kept warm in bed; stimulating poultices of mustard and flaxseed, one to sixteen, were constantly in use over the kidneys, and the pilocarpine was administered three or four times a day. The record for Dec. 26th states: "Took the pilocarpine four times since yesterday morning, and each dose is followed by perspiration lasting from one to one and a half hours; quantity of urine, from f℥vj to f℥viij daily; vomited twice yesterday, not to-day; pulse 104; temp. 97.75°; complains of frontal headache; bowels regular; has considerable salivation. The patient is warm in bed, and the flaxseed and mustard poultice over the kidneys is continued." Dec. 28th, specific gravity of urine 1019: urine still quite albuminous and containing blood-corpuscles and granular casts, also crystals of oxalate of lime. Dec. 30th, takes gr. $\frac{1}{20}$ pilocarpine twice daily, and occasional doses of infusion of digitalis; urine more abundant; it specific gravity 1014, slightly albuminous, and containing very few granular casts and blood-corpuscles; has lost its smoky appearance; reaction alkaline; perspiration slight; patient convalescent.

In another instance, a child of five years, from three to four weeks after scarlet fever was noticed to have anasarca of the face and extremities, with scanty and albuminous urine. One-thirty-second of a grain of muriate of pilocarpine was administered every six hours without the desired sudorific effect. It was then administered every four hours, with an increase of perspiration and urination, so that the nephritic symptoms were relieved and the patient apparently out of danger within three or four days.

In a fourth patient, a girl of three years, having scarlatinous nephritis, with symptoms very similar to those in the last case, the administration of one-twentieth grain doses of pilocarpine in conjunction with the hot-air bath, was followed by increased perspiration and urination, and pro-

gressive and rather rapid convalescence. This child had been taking bichloride of mercury in one-fiftieth grain doses, prescribed by a homœopathic physician, without appreciable benefit. It had been for the most part vomited.

Given, as in the above cases, in moderate doses and with sufficient interval, pilocarpine has never in my practice had any deleterious effect, and I regard it as a very important addition to the remedies for the relief of scarlatinous nephritis. It is apparently the most useful and important diaphoretic for this disease which we possess.

Cathartics, especially those of a hydragogue nature, are also very beneficial. Their action is more certain than that of most diaphoretics and diuretics, and their employment is imperatively required in severe or dangerous cases in which it is necessary to remove as soon as possible the serum or urea which endangers life. Young children or those with delicate stomach, and those much enfeebled by the primary disease, may take magnesia, either the citrate or the calcined. A good cathartic for ordinary cases is a mixture of jalap and potassium bitartrate, the pulvis jalapæ compositus, consisting of one part of jalap and two of cream of tartar. Ten grains of the mixture may be given to a child of five years, and repeated according to circumstances. Its effect is increased by dissolving a teaspoonful of potassium bitartrate in a gobletful of water, and allowing the patient to drink from it. The following is a good cathartic in some instances, especially if the stomach be irritable, so that the more bulky and nauseating catharties are rejected. Care should be taken to obtain a good article, as some of the podophyllin of the shops is not reliable:

℞.—Resinæ podophylli . . . . . gr. j.
Sacchari . . . . . ℥j.—Misce.
Ft. in chart. . . . . No. v.–x.
Sig.—Give one powder, and repeat according to circumstances.

In the treatment of one of the cases reported above it will be recollected that the mild chloride of mercury was given with the podophyllin, with a good result.

After the use of laxative agents the kidneys, being less congested on account of the diversion that has occurred, often begin to excrete urine more freely. But if the patient be anæmic or enfeebled and the symptoms are not urgent, it is frequently better to avoid active catharsis, which more or less reduces the strength, and employ remedies of a sustaining character, as in the following case, which occurred in my practice: A little boy, pallid and scrofulous, began to have anasarca after scarlet fever, chiefly in the scrotum, accompanied by a moderate degree of ascites. The urine, which was passed in nearly the normal quantity, contained albumen, but not in large amount. This patient gradually and fully recovered, with no treatment except the use of an oil-silk jacket over the kidneys and abdomen to promote diaphoresis, and the use of iron. Such a patient, treated by the powerful eliminatives which we employ for the more urgent and robust cases, would probably have been injured rather than benefited. No treatment can therefore be recommended in a treatise on scarlatinous nephritis which will be

strictly applicable for all cases. Variations are demanded according to the state of the patient and the form and gravity of the disease.

Diuretics which do not stimulate the kidneys are proper at an early as well as late period of the renal malady, and digitalis is the one usually prescribed. I do not hesitate to order it from the first day in combination with the acetate of potassium. One teaspoonful of the infusion may be given every third hour to a child of five years. The following formula is for one of this age in good general condition:

℞.—Potass. acetatis . . . . . ʒss.
Infus. digitalis . . . . . fʒvj.—Misce.

The following formulæ are recommended by Meigs and Pepper:

℞.—Potass. bitart. . . . . ʒj.
Spt. junip. comp. . . . . fʒij.
Spt. æther. nitros. . . . . fʒj.
Tr. digitalis . . . . . ♏xv.
Syrupi . . . . . fʒv.
Aquæ . . . . . fʒij.—Misce.
Dose.—One teaspoonful every two hours to a child of two to four years.

℞.—Potass. acetat. . . . . ʒj.
Tr. digitalis . . . . . fʒss.
Syr. scillæ . . . . . fʒj–ij.
Syr. zingib. . . . . fʒv.
Aquæ . . . . . q. s. ad. fʒiij.—Misce.
Dose.—A teaspoonful every two or three hours to children two or three years old.

Local treatment is important. L. Thomas, Romberg, and others recommend the application of leeches, three or more, over the kidneys. Thomas says: "In many cases the abstraction of blood causes immediate and permanent relief; the fever and the pain in the region of the kidneys cease, the secretion of urine becomes augmented, the albuminuria lessens from day to day, and the moderate degree of dropsy that has been developed disappears." It is only in the more robust children, who have been but little reduced by the primary disease, that leeching is, in my opinion, admissible. In the majority of cases instead of depletion a poultice slightly irritating, so as to cause redness of the skin, should be applied over the kidneys, or for older children, not likely to be frightened by the process, the dry cups may be applied daily. In subacute cases, not attended by any alarming symptoms, sufficient redness may be produced by one of the irritating plasters which the shops contain, constantly worn.

Eclampsia, described in the preceding pages, is produced, as we have seen, during the course of scarlet fever by the irritating effect of the scarlatinous poison upon the nervous centres; but, occurring after the decline of scarlet fever, it is ordinarily produced by the retained urea. The same remedies are required to control the convulsive movements as when they occur under other circumstances. The bromide of potassium should be immediately administered in large and frequent doses whenever eclamptic symptoms arise. During eclampsia a child of three years should take five grains of this agent every five to ten

minutes till the attack ceases, and then at longer intervals. The hydrate of chloral is a more powerful agent, and if the eclampsia be not quickly controlled, I commonly employ it per rectum, dissolved in one or two teaspoonfuls of water. For a child of three to five years five grains should be thrown into the rectum by a small glass or gutta-percha syringe, and retained by pressure. Properly administered and retained, it rarely fails to control the eclampsia within ten or fifteen minutes. Subsequently, occasional doses of the bromide should be given to prevent the occurrence of eclampsia while the measures described above are being employed to eliminate the urea.

Rheumatism, endocarditis, and pericarditis, arising as complications or sequelæ, require the treatment which is appropriate when they occur under other circumstances, but the remedies should not be depressing, as the system is already enfeebled by the primary disease. The rheumatism, if mild, usually abates in a few days without medication, and the affected joints require only some soothing lotion and support by a bandage. The following liniment may be applied upon muslin and covered by cotton wadding:

℞.—Acid. carbolici . . . . . f℥j.
Tinc. belladonnæ . . . . . f℥ij.
Ol. camphorati . . . . . f℥ij.

If the rheumatism be severe and affect several joints, the sodium salicylate should be prescribed, as in the idiopathic disease, with an occasional opiate to procure rest.

Endocarditis and pericarditis require rest in the horizontal position, avoidance of all excitement, the use of the tincture or infusion of digitalis or of the fluid extract of convalaria to procure a slow and steady action of the heart. Three drops of the tincture of digitalis or five minims of the fluid extract of convalaria may be given every four hours to a child of five years. The same external measures should be employed as in acute pleuritis. I prefer the application of a thin poultice of flaxseed containing one-sixteenth part of mustard and covered with oiled silk. The cardiac inflammations, as well as rheumatism, require opiates in sufficient doses to procure rest and sleep.

Pleuritis, which we have stated is apt to be suppurative, demands the same treatment as the idiopathic disease when it occurs in cachectic patients.

CHAPTER III.

RÖTHELN.

The disease known as rötheln has heretofore been rare in America. In the Eastern continent, on the other hand, it appears to have been known for many years, and American physicians frequently designate it German or French measles. Meagre and imperfect descriptions of

this malady have appeared in some of the British journals, and cases quite fully detailed have been published by British physicians.

Rötheln is not entirely a new disease in this country, though most American physicians never saw a case of it until since the year 1870. Cases occurring in and about Boston were described by Dr. Honans, Sr., in 1845, and at a later date, namely in 1853 and 1871, B. E. Cotting and Mr. D. Howard saw cases, and described them in papers read before local societies. (See *Boston Med. and Surg. Journal*, March 15, 1873.) In 1874, Dr. Caleb Green, of Homer, Courtland County, New York, an accurate and intelligent observer, also witnessed an epidemic.

This hitherto rare and interesting malady occurred in New York City as an epidemic in 1873 and 1874, attaining its maximum prevalence in March and April of the latter year, after which it declined, occasional cases occurring throughout May. This, so far as I can learn, was the first occurrence of rötheln in this locality. In a general practice of more than twenty years, extending over a considerable portion of this city, I had previously seen nothing like it, and other older physicians, having a large general practice, have informed me that they consider it an entirely new disease with us. Those who believe that they have occasionally observed isolated cases of it, previously to the epidemic, probably refer to roseola.

The first case which I met with occurred in the middle of December, 1873, in West Seventy-first Street, in the northern suburbs of this city. A few weeks later cases were so numerous in the more thickly populated section of New York as to attract the attention of many physicians. It was evident that a disease had appeared with which we were not familiar, and as the eruption occurred in points and small circumscribed patches, it was usually designated by the physicians, in want of a more accurate name, epidemic roseola, or was spoken of as a spurious measles. Physicians who were familiar with foreign medical literature saw the resemblance between these cases and those of rötheln, as described by British and continental writers, but in certain at least of the foreign cases the duration of the rash was said to be seven days (Liveing, London *Lancet*, March 14, 1874, and *Med. News and Library*, May, 1874), whereas in the cases in New York it commonly disappeared by the fourth day. This discrepancy, however, was not sufficient to invalidate the belief in the identity of the New York disease with the foreign rötheln. It was readily explained by the difference in the seasons in which the cases occurred, for Liveing observed his cases in June and July, and, as we will see, the greater the external heat, the longer is the duration of the eruption.

Between the middle of December, 1873, and May 1, 1874, I had observed and treated this malady in eighteen families. Cases occurred in three other families living in the same houses with some of those which I attended, and, as they were fully and clearly described to me, so that there could be no doubt as to their nature, I have included them in my statistics. The total number of cases in these twenty-one families was forty-eight. During May, when the epidemic was declining, I saw six additional cases, occurring singly, making a total of fifty-four. Their ages are given in the following table:

Age.	Cases.
From eight months to one year	2
" one year to two years	4
" two years to five years	16
" five years to ten years	23
" ten years to fifteen years	3
" fifteen years to thirty years	6
Total number of cases	54

The age of the youngest patient was eight months, and that of the oldest thirty years. Seventy-two per cent. of the total number were between the ages of two and ten years; so that rötheln is preëminently a disease of childhood. Individuals in and beyond the middle period of life seem to have nearly an immunity from it. The age of the oldest patient of whom I was informed in the epidemic of 1873 and 1874 was about forty years. On March 25, 1873, during my attendance in the New York Foundling Asylum, rötheln appeared in a boy of four years; in the following month about thirty more cases occurred in this institution, all children, while among the large number of female nurses and employés, who were chiefly between the ages of twenty and thirty years, all but three escaped.

From 1874 to 1880 rötheln did not prevail in New York, unless now and then an isolated or sporadic case, the nature of which was not recognized, and which was supposed to be roseola. On August 9, 1880, two cases appeared in different wards of the New York Foundling Asylum, when it was remembered that two weeks previously these children had been exposed to a patient in the hospital attached to the institution, who had what the physician in attendance supposed at the time to be roseola.

Commencing with these two cases an epidemic occurred in the asylum, mild in type, affecting only a few at a time, but extending over several months, until about sixty inmates, chiefly children, were attacked. Toward the close of 1880 rötheln began to appear in the northern part of the city, in which the asylum is located, and over which my practice extends. Its maximum prevalence was attained in the latter part of March and April, 1881, when it particularly attracted the attention of physicians. A large proportion of the children attending certain public and private schools were attacked. It occurred in seventeen families in my practice. The ages of the patients in these families are given in the following table:

Age.	Cases.
From one to two years	3
" two to five years	8
" five to ten years	18
" ten to fifteen years	11
There were two cases over fifteen years, aged respectively twenty-two and forty-two years	2
Total number of cases	42

PREMONITORY STAGE.—Premonitory symptoms are, in most instances, absent, or so mild as to attract but little attention. It not infrequently

happened in the New York epidemics that the parents or the teachers in the schools were first made aware of the illness of the children by observing the eruption. In some instances children were sent from school, not because they felt too ill to remain, but on account of the unusual appearance of the skin. Sometimes, however, in those old enough to express their sensations, a premonitory stage of some hours, or a day, or even of longer duration, was present; consisting of such symptoms as usually occur when one has taken a severe cold, as languor, pain in the head, trunk, or limbs. The resident physician of the New York Foundling Asylum was so ill with rötheln that he was confined to his bed during the first day of the disease. Now and then patients experience nausea previously to the eruption, and in the first and second days of the eruptive stage. In only one instance did I observe grave prodromic symptoms. A boy, aged eight years, was suddenly seized with clonic convulsions, and while in a warm bath for the relief of these, the rash appeared upon those parts of the body which were immersed in water.

Symptoms.—*Tegumentary System.* (*a*) *The Skin.*—The eruption commonly commences upon the forehead, around the ears, and along the neck, as in measles. Occasionally it may appear upon the back or chest, as in the above-mentioned case, in which the hot water accelerated its appearance. Commencing above the efflorescence travels downward, appearing after some hours upon the lower part of the trunk and on the legs, resembling in this respect the eruption of measles and scarlatina. It occurs upon all parts of the integument, except the scalp and palmar and plantar surfaces. In the majority of the cases which I have seen it gradually faded away, disappearing by the fourth day, but in children who were kept warm in bed, or in warm apartments, it remained longer than on others. In many instances traces of the rash were still visible several days after recovery when the patients were heated by exercise or excitement. It reappeared at times, though indistinctly, on a girl of thirteen years, for three weeks. In most of the cases in the New York epidemics the eruption commonly occurred in points and circular spots, somewhat smaller than those of measles. These points and spots were numerous and thickly set, so that, in the aggregate, they covered at least half of the surface, while between them the skin presented nearly or quite its normal appearance. The general aspect in most cases was more like that of measles than that of scarlatina, but in exceptional instances the skin between the points and spots had a redness similar to that of erythema, and the resemblance was very like the scarlatinous efflorescence. Thus, in a boy of three years, the eruption so closely resembled the scarlatinous over the trunk, that were it not that the temperature was constantly below 100°, and all febrile movements ceased within three or four days, I would probably have considered the malady a mild scarlatina. In certain patients the eruption, beginning in circumscribed spots, like that of measles, becomes in two or three days confluent, so as to resemble that of scarlatina, while over other parts the spots remain discrete. This was the character of the eruption upon the third and fourth days on the extremities of a little boy in the Found-

ling Asylum. The rash is attended by considerable itching, from which, indeed, many patients suffer more than from all other symptoms.

The eruption disappears on pressure, produces a slight roughness of the surface, as ascertained by passing the fingers gently over it, and usually fades away without desquamation. Exceptionally, there is a slight branny exfoliation, and in one of my patients this was as considerable over the abdomen as in cases of scarlatina.

(*b*) *The Mucous Membrane.*—In connection with the cutaneous eruption a mild inflammation also occurs upon the mucous membrane covering the fauces, buccal cavity, and nostrils, and upon reflections of this membrane over the eyes and eyelids, *i. e.*, upon the conjunctiva. In certain patients this inflammation is scarcely appreciable, but in the majority it arrests attention at once. It produces a suffused, reddish, or weak appearance of the eyes, with a moderately increased lachrymation. On everting the eyelids the palpebral conjunctiva is seen to be injected. In certain patients a moderate puriform secretion collects at the inner angle of the eyelids. In occasional cases the conjunctivitis causes œdema of the lids, usually slight, and likely to be overlooked by the physician; but in three instances which I now recall to mind, the mothers of the children directed my attention to the swollen state of the lids. In one of these, an infant of twenty-three months, the tumefaction was so great, commencing about the time the eruption began to fade, that light was totally excluded from the eyes, and it was impossible to ascertain their condition. The skin over the eyelids retained nearly its normal appearance, and a puriform secretion appeared between the lids. In three or four days the œdema of the lids and the hyperæmia of the conjunctiva rapidly declined. The coryza is in most cases sufficient to cause an unpleasant sensation in the nostrils and provoke sneezing; but the flow from the nostrils, though present, was in no instance under my observation as abundant as in ordinary cases of scarlatina, or even of measles. The fauces present an injected appearance, and in severe cases there is moderate swelling of the tonsils. The same catarrhal hyperæmia is also seen in spots or patches, more or less diffused, upon the buccal surfaces. Both the faucial and buccal catarrh are less in degree, however, than in cases of rubeola and scarlatina, which have an equal intensity of cutaneous eruption, and this fact has aided me in differential diagnosis.

The Respiratory System.—In both the epidemics which I have witnessed the mucous membrane of the larynx, trachea, and bronchial tubes participated only slightly in the inflammation which involved the nasal, buccal, and faucial surfaces. Many of my patients had no cough, but others had a mild cough lasting for a few days, but with normal respiration. It was due apparently to a very mild catarrh of the respiratory tract at the time when the nasal and conjunctival surfaces were the most affected. It subsided in a few days without treatment. In no case do I recollect that there was any hoarseness.

The Digestive System.—The tongue in rötheln is moist and of normal appearance, or covered by a slight fur. The appetite may be impaired, but is not wanting in uncomplicated cases. The patients sometimes say that it is nearly the same as in health, the thirst is slight, and the bowels are regular.

Nausea is not infrequent, and vomiting was, in several cases in my practice, one of the initial symptoms. In certain patients it also occurred on the first or second day of the eruption. In others there was no nausea, so far as I could learn, either immediately before or during the prevalence of the disease. This symptom is less frequent in rötheln than in scarlet fever, but is as common apparently as in measles. I have never found albumen in the urine, though I have examined that passed by several patients. This secretion did not appear to be abnormal except as it contained urates, so common in febrile states.

The Pulse and Temperature.—The largest number of accurate daily observations relating to the temperature was, I think, that of Dr. Reid in the New York Foundling Asylum during the month of March, 1874. He has kindly furnished me with his statistics relating to this symptom as follows: "The number of closely observed cases in which the temperature was taken was twenty-four. In seventeen of the cases the temperature ranged from 97° to 99°, in six it reached 100°, 100¼°, and 100¾°; in one it reached 103¼° on the second day of the eruption, but remained so elevated only one day." In certain patients Doctor Reid observed what he designates, "a tendency to the development of an ephemeral fever." These observations correspond closely with those made by myself during the same epidemic. Thus, in 16 cases I found the axillary temperature taken each day to be constantly between 98° and 100°, with a pulse under 110, except in one case, in which it numbered 124. In certain other patients a more decided febrile movement, lasting from one to two or three days, occurred, usually in the commencement of the malady. Thus, a girl aged three and a half years had a temperature of 101¾° and a pulse of 128. In another instance the pulse was 124 and the temperature 102°. In another, a girl of three and a half years, there was active febrile movement occurring without apparent cause on Saturday night; but abating on the following day. She seemed well until the following Tuesday, when the febrile movement returned and the eruption appeared. On Thursday the temperature from 102° to 103° fell to 99½°, and within a day or two she was convalescent. In two other patients from two to four days after the disappearance of the eruption an accession of fever occurred, lasting about one day, and attended by pain and distress in the epigastric region, but without vomiting or diarrhœa. In one of these the temperature was 103¾°, the pulse 130 per minute. In the other case the temperature and pulse did not seem to be under these figures, but were not accurately ascertained. Occasionally the febrile movement is due more to complications than to the primary disease. Thus, in two of my patients the febrile movement was mainly attributable to diphtheritic inflammation which had attacked the fauces. But while the fever in rötheln is ordinarily of short duration, in certain patients temporary exacerbations may occur in which the temperature is as high as in scarlet fever or measles.

Complications—Prognosis.—The only complication which occurred in cases in my practice has already been alluded to, namely, diphtheria, which, when prevalent, is apt to attack surfaces already inflamed. In the Foundling Asylum varicella complicated one case and pneumonia another. In a third pneumonia occurred about three days after the

disappearance of the eruption. The prognosis in uncomplicated cases is always very favorable, and there is no liability to sequelæ more than in mild catarrhal inflammations of a non-specific character. The duration of rötheln is short, not ordinarily extending beyond three to five days.

NATURE—INCUBATIVE PERIOD—CONTAGIOUSNESS.—Is rötheln a distinct malady or one with which we are familiar, but the form and character of which are modified by unusual meteorological conditions? Is it roseola assuming at certain periods an epidemic character, and appearing to be contagious? Or is it at all times infectious, possessing a specific principle, and, like other infectious diseases, self-propagating? Should it in nosological classification be placed among the non-contagious and local, or among the constitutional and infectious maladies? Let us consider the facts observed in the New York epidemics.

The first cases of rötheln in this city were often designated roseola by the physicians called to treat them, since they seemed to resemble more closely this disease than any other with which they were familiar. But rötheln differs widely from the peculiar form of dermatitis known as roseola. The successive occurrence of the eruption over the upper and then the lower parts of the body, but covering the whole surface, and the definite duration of three to five days, are points of difference. Moreover, roseola would not, without so great change in its character as to become virtually a distinct disease, occur in the cool months without any appreciable dietetic cause, as an epidemic over a certain area and for a limited time, affecting whole households and sparing other households, as well as individuals of a certain age. We, therefore, consider it distinct from roseola.

Most of the cases in the New York epidemics bore considerable resemblance to measles, both as regards the appearance and duration of the eruption and the catarrh of the mucous surfaces. Parents often diagnosticated measles before the arrival of the physician, and the physician himself, at first glance, sometimes made the same diagnosis. But in rötheln the shortness and mildness of the stage of invasion, the absence of cough or the presence of one trivial and scarcely noticed, appetite good or but slightly impaired—in fine, symptoms that are transient or slight, afford a striking contrast to the graver symptoms of measles. But the decisive proof that rötheln is not a modified measles is found in the fact that one does not prevent the other. Of the forty-eight cases observed by myself, prior to May 1st, in the epidemic of 1874, nineteen at least had had measles, and one who had rötheln took measles subsequently. I have already stated that in the New York Foundling Asylum rötheln in 1873 and 1874 closely followed an epidemic of measles. A considerable number of the children attacked by the former disease had recently recovered from the latter. During the epidemic of 1880 and 1881 the same fact was observed, namely that a previous attack of measles as well as scarlet fever afforded no protection from rötheln. Dr. Chadbourne, the resident physician, writes of the cases in the Foundling Asylum in 1880 and 1881: "Eight children had rötheln who had had both scarlet fever and measles within six months under my observation, while certain others had had these diseases at some previous time." Of the cases observed by myself in family practice in the same epidemic, it is stated

in my notes that ten had had measles. These statistics are sufficient to show that rötheln is a distinct disease from measles, however close the kinship.

That rötheln is not a form of scarlet fever is evident from the fact that as regards at least the New York epidemics the rash was in most instances quite distinct from the scarlatinous efflorescence, occurring, as we have said, in small more or less circular points and patches. Moreover, as we have remarked above, there is in rötheln a slight febrile movement and general mildness of symptoms, which contrast with the high fever and other pronounced symptoms of scarlatina, or if there be considerable febrile movement its duration is brief. But the conclusive proof of an essential difference between these two diseases is found in the fact already stated in reference to measles, that the attack of the one malady does not prevent the occurrence of the other. There are, it is true, cases in which it is difficult at first to make the differential diagnosis between rötheln and mild measles or mild scarlet fever, but when the course of the malady has been closely observed for three or four days, it will rarely happen, I think, that we will be unable to make out its character.

Those cases of an epidemic which arise when the causes or conditions from which it is developed are most strongly operative and which at this time are apt to be typical, obviously afford the best data for studying its nature. Such were the forty-eight cases which I saw in the epidemic of 1873 and 1874, and the forty-two in that of 1880 and 1881. As regards the former epidemic, in thirteen of the twenty-one families embraced in my statistics, the first cases were children. who up to the time of the seizure were attending public and private schools, and in certain instances those who were nearly simultaneously attacked, living perhaps in streets widely separated, were attending the same school. During the epidemics of 1880 and 1881, the first patients in thirteen of the eighteen families in which rötheln occurred in my practice were school children between the ages of six and twelve years, and in most, if not all, the different schools which they attended, rötheln was at the time prevailing as an epidemic, as I ascertained on inquiry. It, therefore, seemed probable that these children whom I attended had contracted it from others in the schools.

In both the New York epidemics during the time that rötheln was at its maximum prevalence, in most of the families containing two or more children the cases were multiple, not occurring simultaneously, but in succession, as if the malady was contracted from those first affected. This is what we daily witness in the spread of exanthematic fevers. Thus in Mr. E.'s family, a girl attending one of the public schools took rötheln in the middle of December, 1873; the two remaining children sickened with it one week and two weeks later. A niece visiting in the family at the time when the first child was sick, but returning home to another street, also had the eruption on December 27th. Alice R., aged ten years, a frequent visitor at Mrs. E.'s, living in the same street, and several times exposed to his children during their illness, also took rötheln about January 4th. West Seventy-first Street, where these cases occurred, is thinly settled and suburban, and I could learn of no other cases in the vicinity. A child of Mr. P., aged five and a half

years, had been in the habit of playing with two children two doors away who became affected with rötheln in the beginning of April, 1881. On April 14th he was supposed to have a mild coryza from taking cold, as he sneezed often, but in a few hours the efflorescence appeared. Four days subsequently on the 18th, an infant was affected in the same way, and thirteen days later another child in the family, aged twelve years. In a similar manner rötheln occurred in the families of two brothers living in adjoining houses in West Fifty-first Street, The first patient was a boy of twelve years. It appeared successively in the children of these two families until ten had been affected. In a family in West Forty-sixth Street, the first case was a boy attending a school in which rötheln was prevalent. Within twenty days, namely, between March 31st and April 20th, four other children were attacked in succession.

These facts and cases seem to demonstrate the contagiousness of rötheln, at least during the time in which the conditions are most favorable for its development, or during the time in which the epidemic influence is most pronounced. In the declining period of both the New York epidemics, the cases which I observed occurred for the most part singly, although there was no attempt to isolate the patients, so that the contagiousness of the disease, if present, must have been very slight.

Rötheln is, in my opinion, an exanthematic fever feebly contagious. It resembles varicella in general mildness of symptoms, in the absence of dangerous complications or sequelæ, and in the uniformly favorable prognosis, while its symptoms show a resemblance to measles and scarlet fever.

If the above view be correct, rötheln must possess an incubative period which, in the cases observed in both epidemics, apparently varied between seven, or perhaps less than seven, and twenty-one days. Its incubation, therefore, resembles that of scarlet fever, which, as is well known, varies in different patients. In the cases which came under my notice, the incubative period, when it could be accurately ascertained, was more frequently about two weeks, than a longer or shorter period. The resident physician of the New York Foundling Asylum, when the epidemic was prevailing in that institution, returned to his home in the State of Maine to a locality where rötheln was unknown. Fourteen days from the date of his departure he was himself affected with the disease in its typical form. No other case occurred at his home, where probably the atmospheric conditions were unfavorable. Minnie B., attending a school in which there were many cases, had the rash on April 5th. On the 23d of the same month, eighteen days afterward, it appeared upon the servant who was frequently in Minnie's room. Elizabeth C., attending a school in which rötheln was prevailing, had the eruption on April 17th. It commenced upon her sister thirteen days, and upon her mother fourteen days subsequently.

Other cases might be cited of an apparently shorter as well as longer incubative period. The following note from Dr. Chadbourne, of the New York Foundling Asylum, bearing upon this subject, is interesting: "I am led to believe from my observations that the period of incubation

was, in the majority of the cases, from twelve to fifteen days. The disease has been very feebly contagious. In some cases one child would have rötheln while the other, nursed by the same woman, would escape. In two instances women had the disease, and though each suckled two infants the latter escaped."

Rötheln requires no treatment.

CHAPTER IV.

VARIOLA—VARIOLOID.

Variola, or smallpox, is a specific febrile affection, accompanied by a vesiculo-pustular eruption upon the skin. Since the discovery of the protective power of vaccination it has been shorn of much of its terror, but it is still the most loathsome and most dreaded of all the fevers. Two forms of this disease are recognized, depending on the fact whether there have been previous vaccination. If the patient have been vaccinated at some period in his life, the disease, which is rendered milder in consequence, is designated varioloid. If there have been no vaccination, it is called variola or smallpox. Both forms are identical in nature, the one communicating the other; they differ only in gravity.

Smallpox presents four stages: the initial, or that of invasion; the eruptive; that of desiccation; and, lastly, that of desquamation. It is termed discrete when the pustules remain separated from each other; confluent when they unite. This division is made according to the character of the eruption upon the face and hands. There are parts of the surface, as the abdomen, where the pustules are always discrete, even in the confluent form.

Incubative Period.—During the last half of the last century inoculation with variolous matter was extensively practised in Great Britain and on the Continent, as it was found that smallpox thus communicated was milder than when received by infection. This operation enabled physicians to determine the period of incubation, which was found to be from eight to eleven days. When variola is communicated through the air, the incubative period is somewhat longer, to wit, from twelve to fourteen days.

Stage of Invasion.—Smallpox begins abruptly with chilliness. In children of an advanced age there is often, as in the adult, a distinct chill. This is followed by fever and such symptoms as usually accompany febrile movement, namely, lassitude, anorexia, and thirst. In addition certain symptoms arise which, though not peculiar to smallpox, are so marked in the commencement of this disease, that they possess considerable diagnostic value. These symptoms, which pertain to the nervous system and occur in the initial stage of varioloid as well as

variola, are severe frontal headache, pain in the small of the back, and great drowsiness, sometimes with delirium. In many children convulsions occur, preceded and followed by a degree of stupor which is almost as profound as coma. Trousseau suggests the name rachialgia for the pain in the back, as he believes that it is located in or around the spinal cord. This belief is based on the fact which he, as well as other observers, has noticed, that there is sometimes in connection with this symptom an incomplete paraplegia, indicated by numbness of the legs, or even inability to use them, and sometimes more or less paralysis of the bladder. These paraplegic symptoms pass off in a few days. Vomiting is also a common symptom in this stage, and one also of diagnostic value. It occurs at short intervals for twenty-four to thirty-six hours. The same symptom is common in scarlet fever, and not infrequent in measles, but in both these maladies irritability of stomach is much less persistent than in smallpox; vomiting does not occur in normal rubeolous and scarlatinous cases more than once or twice.

The tongue is covered with a moist fur. If the disease is to be discrete, constipation is commonly present in the stage of invasion; if confluent, diarrhœa is a common symptom, continuing till the fourth or fifth day, or even longer. Roseola or erythema sometimes occurs in this stage, and this may lead to error of diagnosis, the disease being mistaken for one of these cutaneous affections, or even for scarlet fever. The symptoms in the stage of invasion are usually more violent in confluent than in discrete variola, but there are exceptions.

Stage of Eruption.—The eruption commences about the third day, earlier in some cases, later in others. The average duration, therefore, of the first stage is somewhat shorter than in measles, but considerably longer than in scarlet fever. Sydenham has stated, and observations show the truth of the remark, that the shorter the first stage, the more severe the disease will prove to be; and, conversely, the longer the period, the milder will be its form. Therefore, if the eruption begin on the second day, it will, as a rule, be confluent; if not till the fifth or sixth day, it will be scanty and the disease light.

The eruption commences in minute red spots, somewhat like those of lichen, which gradually enlarge. It is first observed around the lips and upon the neck, then upon the face, scalp, upper part of chest, arms, and finally upon the lower part of the chest, the abdomen, and legs. It is sometimes, especially in young children, first observed in the folds of the skin, as about the genitals or in the groin. If the cuticle be irritated, as by a sinapism, the eruption often appears first upon this part of the surface and in greater abundance than elsewhere. Commencing in a minute reddish point, as stated above, it rapidly enlarges, and soon its central part begins to be indurated and raised. It feels round and hard to the finger, is tender, and its diameter does not ordinarily exceed two lines. This is the papular stage. The papulæ increase and become more elevated, and in twenty-four to forty-eight hours from the commencement of the eruptive stage they become vesicular. On the fifth day of the eruption, or eighth of the disease, the vesicle has attained its full size. Its diameter is then about one-fourth of an inch, and its elevation is two or three lines. Its base is circular and indurated, and it is surrounded

by a narrow zone of inflammation, indicated by redness and tenderness of the skin. The pock commonly, as it passes from the papular to the vesicular stage, loses its acuminate form, and becomes depressed in the centre, but in most cases, mixed with the umbilicated vesicles, are some which remain acuminate.

In proportion as the eruption becomes developed in discrete variola and in varioloid, the symptoms which accompanied the stage of invasion abate; the fever, headache, pain in the back, and thirst cease, and the appetite returns. In the confluent form, the febrile action continues with little abatement.

Simultaneously with the eruption upon the skin, an eruption also occurs upon the buccal and faucial surfaces, and often upon that of the air-passages. It occurs sometimes, also, upon the conjunctiva, producing dangerous ophthalmia, and even ulceration, with loss of sight, and upon the mucous surface of the genital organs. The form which it presents upon mucous surfaces is somewhat different from that upon the skin. There is at first a deposit of fibrin, producing a small, round, grayish spot at the point of eruption—firm, slightly elevated, and covered, if not by the entire mucous membrane, at least by its epithelial layer. Ulceration soon occurs, as in ulcerous stomatitis, and, if the patient live, the reparative process succeeds, as in simple ulcers. The eruption upon mucous surfaces increases considerably the suffering of the patient, in consequence of the tenderness of the ulcers; and if its seat be the surface of the larynx or trachea, it may be the immediate cause of death, especially in young children, by obstructing respiration.

The cutaneous eruption has been traced to the vesicular stage. On or about the fifth day of the eruptive period, or eighth of smallpox, the vesicles gradually change their character, their contents becoming thicker and turbid. At the same time they increase still more in size, and the central depression disappears. This is designated the stage of maturation, or of suppuration, though it is known that the turbidity is due chiefly to another substance than pus. The pock having undergone these changes, is termed the pustule.

In discrete variola, and in varioloid, the fever returns during the pustular stage; or, if the form of the disease be confluent, and the fever have continued, it now becomes more intense. The return of fever, or its increase, is denoted by increased frequency of pulse, elevation of temperature, dryness of skin, anorexia, and thirst. A tendency to constipation remains throughout in varioloid and discrete variola; in the confluent form diarrhœa more frequently occurs, which, if it continue, is an unfavorable prognostic sign.

Other changes occur. The pustules increase somewhat in size, and become more globular. Some of them, when most distended, break through friction of the clothes, or scratching of the child, and their contents escaping, add to the loathsomeness of the disease. There is in the pustular stage more or less redness of the surface between the eruptions, and, except in the mildest cases, tumefaction from subcutaneous infiltration occurs. In the confluent form, at this period, the features are often so swollen that the friends would not recognize the patient. The eyelids may be so œdematous that the eyes are for a

time concealed from view. This œdema of the surface is not altogether absent in the vesicular stage, but it increases during the time of maturation, after which it subsides.

Stage of Desiccation.—This immediately succeeds the full development of the pustules. The liquid portion of the contents of the pustules which are broken, evaporates, leaving a crust. If there be no rupture, the liquid is absorbed and a scab results, which, though smaller, preserves in a measure the form of the pustule. While the pustule desiccates, the surrounding inflammation rapidly abates. The crusts occur first upon the face, and on other parts in the order in which the eruption appeared. The odor from the patient, at this time, is peculiar. In the confluent form, especially, it is very offensive, and can be noticed at a distance from the bedside. Rilliet and Barthez call it nauseous and fetid. As desiccation progresses, the symptoms, local and general, abate. The pulse and temperature, if the case be favorable, return to their normal standard. The cough, hoarseness, and thirst disappear, while the appetite returns; the sleep is more tranquil, and the functions, generally, are more regularly performed.

The last stage is that of desquamation; it commences between the eleventh and sixteenth days. The scabs, which present a dark or brownish appearance, are successively detached. This period lasts several days; sometimes two or three weeks even elapse before all the crusts separate. In the mean time the patient gradually recovers his health and former strength. After the fall of the crust, the cicatrix underneath presents a reddish appearance. The color gradually fades, and there remains an irregular depression, or pit, of a lighter color than the surrounding surface; and if there have been a full development of the eruption, disfiguring the patient for life.

Such is the clinical history of variola, when it is favorable, and its course is regular. The disease is sometimes irregular. In rare instances the eruption occurs almost at the commencement of the attack. The form is then very apt to be confluent. There are irregularities, also, in consequence of diarrhœa, hemorrhages or other complications. I have known the eruption appear first on the limbs, and last on the trunk and face, and the appearance of the eruption is not always the same. In the anæmic and feeble child it often presents a pale color, with some induration at its base, but without the red areola around it, or with this quite indistinct. In rare instances the vesicles have a reddish color, their contents being tinged with blood. This form of variola is designated hemorrhagic. It indicates a profoundly altered state of the blood. The eruption in this form is of small size, and if the pock is broken, blood oozes from it.

I have met one, perhaps two cases of malignant hemorrhagic smallpox, as described by Hebra, among the rare forms of this malady. The second case died so soon that we were undecided whether he had smallpox or scarlatina. A man aged 36 years, previously healthy, became suddenly and severely sick, in June, 1881, with fever, intense headache and backache, great depression of the vital powers, sleeplessness, and a sensation of sinking or depression in the epigastrium. He had a marked foreboding of coming evil, and begged almost constantly for

relief. Within forty-eight hours a heavy and continuous dusky scarlatiniform eruption covered the whole surface, except below the knees, disappearing on pressure; fauces at first but moderately injected. On the following day, the third of his sickness, with a temperature of 104.5°, the efflorescence became a dark red, numerous small extravasations of blood had occurred under the skin, the urine contained blood, and finally seemed to consist almost entirely of dark blood; a large effusion of blood under the entire conjunctiva of either eye prevented closure of the eyelids, and probably hemorrhages had occurred within the eyes, as the sight was nearly lost. Death occurred on the following day. In Hebra's article on smallpox is the description of precisely such cases, but the death of my patient was too early for exact diagnosis.

Varioloid.—The course of varioloid is similar to that of variola, but it is somewhat shorter. It commences with rigors, followed by fever, headache, pain in the back, vomiting, drowsiness and sometimes delirium, or even convulsions. The symptoms in the stage of invasion are, indeed, the same in character, and often nearly as severe as in variola. With the initial symptoms, there is also sometimes a scarlatiniform eruption, so that the disease may at first be mistaken for scarlatina. On the third or fourth day the variolous eruption commences. The number of pocks is commonly few, often not more than twelve to twenty. In the mildest form of varioloid, if the physician be not summoned in the stage of invasion, he is not apt to be called at all, so that the patient may pass through the disease in ignorance of its nature. The true character of the malady is not ascertained till others are affected, either with variola or varioloid.

The eruption pursues a more rapid course in varioloid than in the unmodified disease. By the fifth or sixth day the pustules are fully developed, though often smaller and less likely to be ruptured than in variola. Often, in varioloid, the eruption aborts. It remains papular two or three days, and then declines, or it may reach the vesicular stage, and decline without pustulation.

The constitutional symptoms in varioloid abate with the commencement of the eruptive stage. The secondary fever is slight or absent.

Such is the usual mild course of varioloid, but not always. If several years have elapsed since the vaccination, its protective power is greatly impaired, and varioloid may then exhibit as severe a form as ordinary smallpox. In some instances it is fatal.

The term varioloid is, as has been stated, applied to cases of variolous disease if there have been previous vaccination. It is also applied by writers to second attacks, whether the first occurred from infection or from variolous inoculation, but such cases are rare.

Mode of Death.—Death in smallpox occurs in several different ways. The most fatal period is the pustular. Feeble children not infrequently die from exhaustion at or about the time that the pustules attain their greatest size. The eruption appears and becomes developed as usual, but there are evidences of weakness in the patient, and suddenly the progress of the vesicle or pustule ceases. It begins to subside, and its walls shrivel. There is evidently absorption, in part, of the liquid contents. These phenomena are of the gravest character.

Death is the common result, and within twenty-four hours. In other cases death occurs from apnœa. The pock increasing in size in the larynx and trachea, obstructs inspiration, or there may be the formation of a pseudo-membrane, as in true croup. This is not an unusual mode of death in young children, in whom the calibre of the larynx and trachea is small. Sometimes convulsions and coma occur in the last hours of life. In other cases the stage of desquamation is reached, but convalescence does not occur. The patient each day becomes more anæmic and feeble, and finally death results from failure of the vital powers. Again, after smallpox has run its course, purpura hæmorrhagica may be developed. Hemorrhages occur from the gums, throat, nostrils. Blood is vomited, and evacuated in the stools. I have known death to occur in all these ways, but that from purpura is least frequent. Sometimes, as in scarlet fever, death occurs suddenly and unexpectedly in confluent, and even in discrete variola, when the previous symptoms had apparently been favorable. The patient is overpowered by the intensity of the virus.

Anatomical Characters.—In those who have died of variola, without inflammatory or other complication, the heart-clots have been found small, dark, and soft. The blood is dark and thin. The vessels of the brain and its membranes are injected, so that numerous red points appear on the cut surface of this organ. The vessels of the lungs and the abdominal organs are congested, while the muscles present a deep red color. The variolous eruption penetrates more deeply than that of any other exanthematic fever. It has been stated elsewhere that it occurs not only on the skin, but often on the surface of the mouth, fauces, and air-passages. The mucous membrane in these situations is frequently also the seat of catarrhal inflammation, being thickened and softened, and in some parts, as the larynx, a pseudo-membrane is occasionally produced, as in croup.

The eruption very seldom, perhaps never, appears upon the gastro-intestinal surface, but the solitary follicles and patches of Peyer are often enlarged, as in some other zymotic affections. The liver, spleen, and kidneys are commonly congested in those who have died of variola. The spleen, especially, is increased in volume and softened; the kidneys are enlarged, as from commencing nephritis, and sometimes softened.

The minute structure of the pock is described by Rilliet and Barthez, and others. The vesicle is multilocular, consisting of at least five or six compartments, with distinct partitions. Its centre is united by fibrous bands to the derm beneath, which union gives rise to the umbilicated appearance. The giving way of these minute bands in the pustular stage occurs when the form changes from the umbilicated to the convex. In the pustular stage also, according to some, a fibrinous formation occurs within the pustule; according to others, this substance is of the nature of the epidermis, presenting the appearance of the cuticle when macerated. Mixed with this epidermic or fibrinous formation are pus-cells.

Complications.—There are several different complications of variola. One is salivation. This is common in the adult, but rare in the child. When it occurs in the child, it is slight, commencing with or about the

time of the eruption, and disappearing in from one to four or five days. Ophthalmia is another complication. Simple conjunctivitis, often quite intense, may occur in consequence of pustules developed under the lids. This inflammation subsides without injury to the eye, as the primary disease abates. A more serious inflammation occurs at an advanced stage of variola, commencing in or near the desquamative period. This produces more or less chemosis, and sometimes opacity or ulceration of the cornea. A similar inflammation may occur in the ear, giving rise to otorrhœa, and even, in some patients, to rupture of the drum of the ear. Abscesses in the subcutaneous connective tissue have been occasionally observed, especially in the confluent form. Subcutaneous infiltration and feebleness of constitution favor their occurrence. Suppuration within the joints is a somewhat rare complication or sequel, rendering convalescence protracted, if, indeed, the case be not fatal.

M. Béraud has published a memoir to show that orchitis in the male and ovaritis in the female may complicate variola. These inflammations are believed to be accompanied by a small and imperfect variolous eruption upon the tunica vaginalis and the peritoneal covering of the ovary. Trousseau states that he has often met this complication in the male, since his attention was called to it. It is mild, and subsides with the disappearance of the eruption. Laryngitis, simple or diphtheritic, bronchitis, pneumonia, pharyngitis, purpuric hemorrhages, gangrene of the mouth or other parts, œdema pulmonum, and œdema glottidis are occasional complications, some of which are frequent, others rare.

Prognosis.—This depends on the age, vigor of system, form of the disease, and the presence or absence of complications. The younger the child, the greater the danger. Trousseau says: "Confluent variola, and even discrete variola, are almost always fatal in individuals less than two years old." Above the age of three or four years discrete variola usually ends favorably, but the confluent form is still, as a rule, fatal. Varioloid in the child is a mild disease, terminating favorably in a large proportion of cases. It is milder at this age than in the adult, on account of the more recent period of vaccination. If varioloid be severe, and the eruption abundant in a child who has been vaccinated, it is probable that the vaccination was spurious.

It is not necessary, from what has been said, to specify the favorable prognostic signs. The unfavorable prognostics are, great violence of the initial symptoms; early appearance of the eruption; an abundant eruption, especially if pale, and without swelling of the surface; rapid decline of the eruption in the vesicular or pustular stage; hemorrhagic eruption, or hemorrhages from the surfaces; fever continuing after the appearance of the eruption; diarrhœa persisting beyond the third or fourth day; delirium or great drowsiness; a frequent and feeble pulse; and, finally, obstructed respiration—if slow, indicating a pseudo-membrane or variolous eruption in the larynx or trachea; if rapid, indicating bronchitis or pneumonia.

Diagnosis.—The diagnosis cannot be made with certainty prior to the eruptive stage. If, however, smallpox be prevalent, if the patient have not been vaccinated, and the symptoms which pertain to the period of inva-

sion be present, as headache, pain in small of back, repeated vomiting, drowsiness, and perhaps convulsions, there is ground for the gravest suspicion. If, in addition to these symptoms, reddish points begin to appear on the second or third day, the diagnosis may be made with confidence. At this early period, even before there is any distinct cutaneous eruption, ash-colored spots may sometimes be observed on the buccal or faucial surface, the commencement of the variolous eruption; these possess considerable diagnostic value.

The scarlatiniform efflorescence, in the first stage of variola, sometimes leads to the belief that the disease is scarlet fever. The absence of the pharyngitis, and the appearance of the variolous eruption soon after the efflorescence, correct the diagnosis. Smallpox has, in the beginning of the eruptive period, sometimes been mistaken for measles. The points involved in the differential diagnosis have been presented in treating of that disease. After the development of the eruption, it may be mistaken for varicella. The eruption of varicella, is, however, preceded by symptoms which are milder and of shorter duration, and its appearance is different. It is irregular, instead of round; is not umbilicated, and it does not have the round, inflamed, and indurated base which characterizes the variolous eruption. The eruption of ecthyma is sometimes umbilicated, but the symptoms of ecthyma and variola, and the progress of the eruptions in the two diseases, are very different.

TREATMENT.—Smallpox, like the other essential fevers, is self-limited, and therefore the constitutional treatment should be sustaining and palliative. In the first stages of the disease, the diet should be simple; gentle laxatives and refrigerant drinks are required if there be much febrile excitement. Lemonade is a grateful drink, and may be given in moderate quantity. Spiritus mindereri in carbonic acid water may be allowed. As the disease advances, more nutritious food should be recommended; and in severe cases carbonate of ammonium, and even alcoholic stimulants, are required.

As confluent smallpox is nearly always, and the discrete form often fatal in infancy, the physician should carefully watch the progress of the case in the infant. By judicious treatment, some, in this period of life, may be saved, who otherwise would perish. In the infant depressing measures should be avoided. A laxative may be given, at first, if there be much fever, and the bowels are constipated; but the diet should be nutritious, and many soon require tonics and stimulants. If the pulse become more frequent and feeble, or if, with frequency of the pulse, the face and extremities become cool; or, in the vesicular or pustular stage, the eruption suddenly subside, alcoholic stimulants must be immediately employed, or the patient dies.

Such is an outline of the constitutional treatment required in smallpox. Sydenham inculcated a mode of treatment which experience has shown to be injurious in infancy and childhood. He had observed that the severity of the disease was ordinarily proportionate to the amount of eruption, and concluded from this fact that measures which retarded the development of the eruption were salutary; cold drinks, a cold apartment, scanty covering of the body, cathartics that caused derivation of the blood from the surface, even sometimes the abstraction of

blood, were considered, according to Sydenham's theory, to be useful as means of preventing full development of the eruption.

Sydenham's treatment, however appropriate it might sometimes be in case of robust adults, is unsuitable for children, because they do not, as a rule, tolerate, in this disease, measures which reduce the strength. Moreover, smallpox is rendered more dangerous by what Rilliet and Barthez designate perturbating treatment—treatment which renders it abnormal. The regular appearance and development of the eruption are requisite in order that the case may progress favorably. On the other hand, the opposite plan of treatment, which families, if left to themselves, are apt to adopt—namely the employment of measures to promote perspiration, as hot drinks, and confinement in a heated room—is also injurious.

The patient should be kept in a temperature such as he has been accustomed to, and such as is agreeable to him; his diet should be simple and nutritious; laxative medicine should only be given to procure the natural evacuations. In smallpox, as in all infectious diseases, free ventilation of the apartment is required.

While the general eruption should not, as a rule, be interfered with, it is proper to endeavor to diminish, so far as possible the size of the pocks, on parts exposed to view, so as to prevent disfigurement. Professor Flint, in his *Treatise on the Practice of Medicine*, has published an excellent summary of the various measures which have been recommended for accomplishing this end. First: The opening and breaking up of the vesicle by means of a fine needle. This is tedious practice in confluent variola, but it can readily be performed in the discrete form—at least as regards the vesicles upon the face. This treatment was proposed by Rayer, and it is recommended by many who have tried it. Secondly: After the evacuation of the liquid, the cauterization of the vesicle by a pointed stick of nitrate of silver. Rilliet and Barthez say, in reference to this mode of treatment, "Individual cauterization of the pustules is, on the other hand, an almost infallible means of causing them to abort. To be successful, it is necessary to penetrate into the interior of the pustule with a pointed crayon of nitrate of silver in order to cauterize the derm. . . . It is only the first or second day of the eruption that it (cauterization) has certain success; nevertheless, we have often seen it succeed the third or the fourth day, or even the fifth."

Thirdly: The application of tincture of iodine once or twice daily over the eruption when in the papular stage. Some writers, who have employed iodine, state that it does not prevent pitting but diminishes it. Its favorable effects are produced by coagulating the contents of the papule. Fourthly: The exclusion of light and air by means of a plaster. A mixture containing tannate of iron has been employed for this purpose in one of our hospitals. This produces a black mask. Light and air may also be excluded by smearing the face with sweet oil, and dusting twice daily upon the oiled surface a powder containing equal parts of subnitrate of bismuth and prepared chalk. Fifthly: The application of mild mercurial ointment upon the face or other parts of the surface, where it is desirable to render the eruption abortive. This mode of

treatment does diminish the size of the vesicles and the pitting, but I should not recommend it for children. I have known in the adult severe mercurialization from its employment for four or five days, and, though young children do not exhibit so readily the effects of mercury, the use of the ointment, unless for a very limited period, increases, in my opinion, their feebleness, and diminishes the chance of their recovery. Calamine made into a paste with sweet oil is said to be equally effectual with mercurial ointment, and it produces no constitutional effect. Its effect is obviously similar to that of the bismuth and chalk employed with sweet oil as stated above. Also, I have employed pulverized charcoal made into a thin paste with sweet oil or glycerine, and applied daily or twice daily to the face. It effectually excludes the light, and the result appeared to be good as regards pitting, but it is a disagreeable application. Curschmann recommends as preferable to any of these methods, the use of iced compresses to the face and hands, The pain, redness, and swelling are diminished by their use, but without change in the copiousness of the eruption. (*Ziemssen's Encyclop.*) If fissures or excoriations occur, an application may be made of oxide or carbonate of zinc in glycerine, one drachm to the ounce.

The prevention of smallpox, so far as practicable, is one of the important incidental duties of the physician. Isolation of the patient, and precautions in reference to his clothes and bedding, are imperatively required, so great is the contagiousness of this disease. The only certain means of prevention is vaccination, and providentially the incubative period of the vaccine disease is less than that of variola. Therefore, smallpox may be prevented after the virus is received in the system, by timely and successful vaccination. Vaccination, at any period between the time of exposure and the commencement of the symptoms of invasion, will either prevent the occurrence of smallpox or modify it. If the symptoms of invasion have already commenced, it is uncertain whether it produces any modifying effect.

CHAPTER V.

VACCINIA.

Vaccinia is a mild eruptive disease, which occasionally occurs among cattle, and has been propagated from them to man. It is characterized by the appearance upon the surface of one or more papules, which soon become vesicular, and then pustular. It is communicable by contact, but, unlike the other eruptive fevers, it is not contagious through the air. It is inoculable, both by the liquid contained in the vesicle, which is designated vaccine lymph, and by the scab which results from the desiccation of the pustule.

To Gloucestershire, England, the honor belongs of discovering and utilizing the fact that vaccinia, a mild and comparatively harmless disease, is transmissible from the cow to man, and that it affords protection from smallpox. It appears that a vague opinion prevailed among the farmers of this dairying section, that a disease, which has since been designated vaccinia, was occasionally received from the cow in milking, the virus passing from a pustule on the teat to a sore or chap on the hand of the milker, and that those who thus contract the disease receive immunity from smallpox. As usually happens with important discoveries, so slow of apprehension is the human intellect, these people, to whom Providence had revealed a most important fact, were blind to its real value. Finally in the year 1724, Benjamin Jesty, whom the world has not sufficiently honored, "an honest and upright man," according to his epitaph, a farmer of Gloucestershire, had the courage to vaccinate his wife and two children. His excellent moral character did not shield him. He was regarded by his neighbors as an inhuman brute, who had performed an experiment on his own family, the tendency of which might be to transform them into beasts with horns.

This first essay in vaccination appears to have been entirely successful, but the prejudice against the operation continued. A fifth of a century passed, during which there was no extension of the benefits of this great discovery. At last, toward the close of the last century, Dr. Edward Jenner, a physician of Gloucestershire, an inoculator of his district, began to investigate this disease of the cow, about which little was known, and the grounds for the belief that it afforded protection from smallpox. Fortunately for the world, Jenner had been educated under John Hunter, and had learned from his great master to study nature rather than books, to be guided by experience and observation rather than by the dogmas of his predecessors or of the schools.

Jenner performed his first vaccination on the 14th of May, 1796, twenty-two years after Benjamin Jesty had lost his good name among his neighbors by vaccinating his own family. The popularizing of vaccination, mainly through Jenner's perseverance, affords one of the most interesting and instructive chapters in the history of medical science. How he went up to London, full of the importance of the discovery, and was there advised by his medical friends to desist from his wild schemes, lest he should injure the reputation which he had gained from a creditable paper on the habits of the cuckoo; how he was finally allowed to vaccinate in hospital wards, and gained some adherents to the new faith among the leading physicians of the metropolis; and, finally, how, as the claims of vaccination began to be recognized, at the close of the last century and commencement of the present, a most acrimonious discussion arose, which filled all the medical journals of that period. The opponents of vaccination resorted to every device to prevent the acceptance of Jenner's views. They attempted to prejudice the people against them by specious arguments, by ridicule, and even by caricatures. One of the leading journals contained the picture of a cow covered with sores, and devouring children, and it was urged that vaccination was a bestial operation, degrading man to the level of the

brute. But the truth had gained a firm hold, and the practice of vaccination extended.

The discovery of vaccinia, and of its protective power, cannot be too highly appreciated. It has, probably, done more to relieve human suffering than any other discovery of the last one hundred years, unless we except that of anæsthetics, and more to save human life than any other instrumentality of a purely physical kind.

The fact was established in the time of Jenner, that the virus of smallpox inoculated in the cow produced vaccinia, which, in its propagation back to man never returned to its original form, but always remained vaccinia. Moreover, Jenner believed that the disease known in the horse as the grease was identical in nature with vaccinia in the cow. He failed, however, in his experiment to communicate vaccinia from the horse, but other experiments have been more successful. In 1801, a Dr. Loy, of the county of York, England, met two cases of vaccinia in persons who had taken care of a horse affected with the grease, and, from the lymph which he obtained, was able to produce vaccinia in the cow. In 1805, Viborg, a Danish veterinary surgeon, after many failures, succeeded also in communicating vaccinia to the cow by means of the virus taken from a horse.

From this time little light was thrown on this subject till within the last twenty years. Although Loy and Viborg, and perhaps a few others, had recorded their success, other experimenters had failed to communicate vaccinia from the horse. In the absence of additional cases the profession began to question whether there might not have been some error in the observations of the gentlemen whose names I have mentioned, and whether a disease identical with vaccinia occurred in the horse, or a diease which might communicate vaccinia to the cow or to man, was still regarded as undetermined.

Observations confirmatory of those of Loy and Viborg were at length, however, made, which must be regarded as conclusive. In 1856, in the department of L'Eure-et-Loir, France, M. Pichot was consulted by a boy who had on the back of his hands vaccine pustules, which had apparently reached the eighth or ninth day. He had not taken care of nor been in contact with a cow, but had a few days before taken care of a horse affected with the grease. Vaccination was performed by means of the lymph taken from these pustules, and genuine vaccinia was produced.

Again in 1860, an epidemic prevailed among the horses in Riemes and Toulouse, France. A mare sickened with the disease, and there was swelling of the hough, with discharge of sanious matter. M. Delafosse vaccinated two cows with this matter, and communicated genuine vaccinia. This epidemic was believed by the veterinary surgeons to be an eruptive fever, differing in its nature somewhat from the disease or diseases which have ordinarily been designated the grease. It has been conjectured that two or more distinct affections of the horse have the same appellation, one of which, it is now admitted, is identical with vaccinia of the cow, and may communicate it; and the reason why so many experimenters have failed to vaccinate the cow from the horse is that they have used the virus of the wrong disease, or have taken virus from

horses which had been affected with the true disease, but from ulcers which had lost their specific character.

Prior to the time of Jenner variolous inoculation was practised in most civilized countries, since variola produced in this way was found to be milder than when arising from infection. This practice is now obsolete; forbidden in some places by legislative enactments. It is superseded by vaccination. Vaccination, or the introduction of vaccine lymph into the system, is quickly and conveniently performed by scarifying with a lancet, and rubbing into the incisions the lymph, or a little of the scab pulverized and dissolved in a drop of cold water. It may also be performed by scraping off the epidermis with the edge of the instrument till the blood begins to ooze; and also, though with less certainty of success, by puncturing the skin with the point of the lancet, or by an instrument called the vaccinator. The scab should never be employed when it is possible to obtain pure lymph, since it contains animal matter apart from the virus, and may be the medium through which other diseases may be communicated. Besides it is much less active than pure lymph.

If the child have a vascular nævus, this may be selected as the point of vaccination. Unless of large size, it can usually be cured by the inflammation which vaccinia produces. Statistics collected by Simon, as well as Marson, show that of those who contract varioloid, the larger the number of vaccine cicatrices the milder the disease, and the less the proportionate number of deaths. In Simon's statistics of those who stated that they had been vaccinated, but who presented no cicatrix, $21\frac{3}{4}$ per cent. died; of those who had one cicatrix, $7\frac{1}{2}$ per cent. died; of those who had two, $4\frac{1}{8}$ per cent. died; of those who had three, $1\frac{3}{4}$ per cent. died; while of those who had four or more cicatrices, only $\frac{3}{4}$ per cent. died. These statistics would seem to indicate the propriety of vaccinating in several places. But, so far as appears, when two or more cicatrices were observed, the patients may have been vaccinated at different times, at intervals, perhaps of several years, and if so, the inference would not follow that more complete protection is produced by vaccinating in several places than in one. Moreover, if vaccination be performed in the usual manner by several incisions on the arm, and the virus be fresh and active, usually two or more distinct vesicles arise, which unite in their development and probably protect the system as much as if they were separated by a wider space.

Appearances—Symptoms.—In genuine vaccination no effect is observed, except the slight inflammation due to the operation, till the close of the third day. Then the specific inflammation commences. This is indicated by a small red point, at first scarcely visible, indurated and slightly elevated, as determined by the touch, rather than by the eye. This increases, and on the fifth day the cuticle over the inflamed part begins to be raised by a transparent and thin liquid. The vesicle increases in diameter, and by the sixth day presents an umbilicated appearance, and is surrounded by a faint and narrow red zone. At the close of the eighth day the vesicle is fully developed. Its size varies considerably. It is usually from a sixth to a third of an inch in diameter, and oval or circular. If the vaccination have been performed by incisions, the size of the matured vesicle may be considerably larger,

and its shape irregular, in consequence of the union of two or more vesicles. The eruption now presents a whitish or pearl-colored appearance, due to the whiteness of the cuticle, and the transparence of the liquid underneath. If the vaccination be performed by incisions, it is not unusual to observe over the centre of the vesicle, and adhering to it, a small yellowish scab, which has resulted from the scarification, and which contains none of the virus.

The vaccine vesicle, like that of variola, consists of compartments, commonly eight or ten, with complete partitions, so that there is no intercommunication. On the ninth day the inflamed areola becomes more distinct, and its diameter rapidly increases. Its color is deep red, its temperature is considerably elevated, and it is accompanied by more or less induration of the subcutaneous tissue, and it is tender to the touch. On the tenth day the pock has reached its full development. The areola then extends from one to two inches away from the vesicle, becoming fainter at its outer circumference, and gradually disappearing in the healthy skin. The shape of the outer circumference of the areola is irregular, projecting further at one point than another, though its general form is circular.

On the tenth day, when the inflammation has reached its maximum, the heat, itching, and tenderness in and around the pock are such that the child is often feverish and restless. Occasionally the glands of the axilla become swollen and tender. In other cases, in which there is but a moderate amount of inflammation, the constitutional disturbance is slight.

At the close of the tenth day, or on the eleventh, the inflammation begins to decline; the areola becomes narrower and then disappears; the induration and tenderness abate; and with this change the pustule desiccates, its liquid is absorbed, and there results a brownish or a dark mahogany-colored scab, which is detached, ordinarily, between the fourteenth and twenty-first days. The cicatrix, at first reddish, like all recent cicatrices, gradually becomes paler, and remains whiter than the surrounding integument. It presents several minute depressions or pits, which indicate the genuineness of the vaccination.

The theory that smallpox becomes vaccinia by passing through the heifer, as we have given it above, has for many years been undisputed. But recently the theory has been promulgated that vaccinia and variola, instead of being forms of the same disease, are essentially distinct; that when the heifer is inoculated with the virus of smallpox the disease which is produced is a modified smallpox but not vaccinia, which occurs as a spontaneous disease among cattle. It may be that the old theory, which no one doubted until recently, is wrong, but that vaccination prevents smallpox, just as a mild attack of scarlet fever prevents a severe attack of the same disease, shows, in my opinion, a close relationship between vaccinia and the severe malady which it prevents. We wait for more conclusive facts in support of the new theory, before accepting it.

ANOMALIES, COMPLICATIONS, AND SEQUELS.—The vesicle is often broken, accidentally, or by the nails of the child. If the top of the vesicle be destroyed, or most of the compartments be opened, the inflamma-

tion is commonly increased, considerable suppuration occurs, and there results a large, irregular, yellowish scab, consisting of the virus mixed with desiccated pus. This scab is entirely unreliable, and unfit for the purpose of vaccination, though the protective power of the disease is not diminished by injury of the vesicle, even if it be totally destroyed. The cicatrix which results from extensive injury of the vesicle is apt to be large, and without the indented points which characterize the normal cicatrix.

In rare cases when the inflammation which surrounds the vesicle is intense and deep seated, suppuration occurs in the subjacent connective tissue, giving rise to an abscess. This abscess is commonly of small size, but it increases the fretfulness and constitutional disturbance which attend vaccinia. This subcutaneous suppuration occurs most frequently in those who have a scrofulous or vitiated state of system. Inflammation of the lymphatic glands of the axilla I have spoken of as not infrequent in vaccinia. This sometimes proceeds to suppuration, producing an unpleasant, though not serious, complication.

It sometimes happens that vesicles appear in other parts besides the points where the virus was inserted. These supernumerary vesicles commonly occur where the cuticle has been removed by scalds or injuries.

Trousseau relates the case of an infant whom he had vaccinated. On the eleventh day he was astonished to find twenty-seven vaccine pustules on the face, trunk, and limbs. This infant had, however, before the vaccination, a simple non-specific eruption over the whole body, and it was believed that it had produced these vaccinations by transferring the lymph, with its nails, to the various parts where the cuticle was denuded.

It is not unusual, also, to observe minute papules appearing on parts of the surface simultaneously with or soon after the vesicle, and in a few days declining. These seem to be abortive vaccine eruptions.

One of the most serious complications is erysipelas. This may occur directly from the operation, or from the inflammation caused by the vesicle, when the virus possesses no deleterious property; and again, it may result from some unknown element in the virus. It may occur immediately after the operation, when it commonly prevents the working of the virus, or during the vesicular or pustular stage; or, again, after desiccation and separation of the scab. I have observed it at all these periods.

Erysipelas, occurring as a complication of vaccinia, is invariably referred by the friends to the virus employed, and the physician who has had the misfortune to vaccinate is often unjustly blamed. In many of these cases there is a strong predisposition to erysipelas at the time of the vaccination, and the operation or the inflammation which accompanies the normal development of the visicle serves simply as an exciting cause. Erysipelas would occur as soon from a non-specific sore; indeed, we not infrequently are called to cases of this disease in young children, which commence from non-specific sores upon the genitals, or on one of the limbs. That the fault is not in the virus employed, is evident from the fact that other children, vaccinated with the same, have simple uncomplicated vaccinia.

Sometimes, on the other hand, the cause of erysipelas, whatever it

may be, exists in the virus. For further facts in reference to this subject, the reader is referred to our remarks on erysipelas.

The fact is established by many observations that syphilis is communicable by vaccination. The symptoms of it may not appear till vaccinia has terminated, or for a little time subsequently, but it then constitutes a very serious sequel. A physician of this city, well known in this community as skilful in the diagnosis and treatment of skin diseases, and therefore not likely to be mistaken as regards the nature of the diseases, states that he communicated syphilis to two infants by vaccinating with the same scab. Both had the characteristic syphilitic eruption. In January, 1868, an infant was brought to Prof. Alonzo Clark's clinique, in this city, having syphilitic rupia, which, in the opinion of the physicians present, was undoubtedly the result of vaccination.

Trousseau relates the case of a young woman, eighteen years old, who was vaccinated with virus taken from an infant apparently in perfect health. The vaccination was unsuccessful; but twenty-three days subsequently his attention was called to an eruption which had appeared in two places on the woman's arm, corresponding with the points where the virus had been inserted. The eruption was that of ecthyma, which, by the next examination, which was five days subsequently, had been transformed into rupia. The axillary lymphatic glands were tumefied and indolent, and finally roseola appeared, which removed all doubts as to the syphilitic character of the disease. There was syphilitic infection, which first manifested itself in the points where vaccination had been performed (*Article de la Vaccine*). It is not ascertained in Professor Clark's case, nor is it stated in Trousseau's, whether the lymph or scab was employed for vaccination. There can be little doubt that the pure lymph never communicates anything but vaccinia, and if by vaccination any other disease be imparted, a little blood has mingled with the lymph, or the scab has been employed.

The vesicle in genuine vaccinia is sometimes very small, not having a diameter of more than two lines. Occasionally the development of the vesicle is retarded. It does not appear till two or three days later than the usual time, or even a longer period.

Vaccinia is modified by certain diseases. It is arrested by measles and scarlet fever, pursuing its course after the subsidence of the exanthem. On the other hand, it sometimes modifies the paroxysmal cough of pertussis, but only during the time when the pock is maturing. Eczamatous eruptions occasionally occur after vaccinia, as they often do after the other eruptive fevers, or, if already present, they may be aggravated.

Subsequent Vaccinations.

A second vaccination, performed prior to the ninth day after the first vaccination, is successful. A genuine vaccine eruption results, which is smaller the more advanced the primary disease. This second eruption overtakes the first. On the ninth day the susceptibility to vaccinia is, in most cases, lost; so that vaccination performed on the tenth, or subsequent days, is unsuccessful.

As a rule, an acute contagious disease occurs only once in the same

individual. Vaccinia is an exception. In most people, after a few years, it can be produced a second time; and cases of a third or fourth successful vaccination, at intervals of a few years, are not uncommon. Now, subsequent cases of vaccinia differ from the first, which has been described above. The period of incubation is shorter, and the vesicular, pustular, and desiccative stages succeed each other more rapidly, so that the whole period of the disease is less. The variation from the appearance and course of the first vesicle is proportionate to the degree of protection which the first vaccination still affords, both as regards smallpox and vaccinia. If several years have elapsed since the first vaccination, and the protective power which it affords is nearly lost, the second vaccinia differs but little from the first. If, on the other hand, the first vaccination still afford nearly complete protection, the result of the second is slight; the eruption is insignificant, lacking the characteristic appearance of the vaccine vesicle, resembling a common sore, and disappearing within a week. It is not accompanied by the inflamed areola, or any appreciable constitutional disturbance.

Vaccination often produces no result. This is sometimes due to the fact that the lymph or scab employed is useless. It has spoiled by keeping, or never has been good. In other cases it is due to a lack of susceptibility in the person. Some take vaccinia with difficulty, and only after several vaccinations; just as children, though fully exposed, often fail to take measles or scarlet fever, on account of a condition of the system which prevents the reception of the virus, or antagonizes and controls its action. In some instances, after vaccination, an eruption is produced, which may or may not be genuine; but it immediately becomes purulent, and is soon broken. A large yellow, uneven scab results, having none of the appearance and containing little or none of the vaccine virus. This scab, as well as the liquid matter which preceded the formation of the scab, is utterly useless for the purpose of vaccination, and, if so employed, will probably cause a sore from its irritating effect, but not of a specific character. If, in place of the true vaccine vesicle, the eruption present the appearance which I have described, namely, that of a pustule, soon breaking and forming a large irregular, yellowish scab, the vaccinia —if it be correct so to designate it—must be considered spurious. A sore has been produced by the animal matter which was employed in the vaccination along with the virus, which has modified the action of the virus, and probably has rendered it useless as a means of protection; or there may have been no virus inserted with this animal matter. The physician should in such cases insist on a second vaccination.

Cases like the above are of frequent occurrence, and the parents of the child are often satisfied with the result. They see an eruption following vaccination, accompanied by considerable inflammation, and leaving a cicatrix. Unless undeceived by the physician, they are apt to remain in the belief of the child's security, until, perhaps, it takes smallpox. Such cases, obviously, tend to diminish the confidence which the public should have in vaccination as a means of protection from smallpox, and on account of their frequent occurrence it is important in every case that the physician should see the result of his vaccination. It has been proposed, as a means of determining the genuineness of vaccinia,

to revaccinate when the eruption begins, and if the first be genuine, the second will overtake it. This is called Brice's test; but it is not necessary, since the physician, familiar with the appearance of the true vesicle, can determine at once its genuineness by the sight.

Protection from Vaccination—Revaccination.

It was believed by the early advocates of vaccination that the general performance of this operation would soon eradicate smallpox from the community, so that it would be interesting only to the medical historian as a scourge of past ages. This result, however, is not achieved. As a rule, the greater the benefit of any measure designed to ameliorate the condition of mankind, the greater and more numerous are the obstacles which diminish its effectiveness. Science is full of examples of this. Fortunately these obstacles, as regards vaccination, are not such as to impair the confidence of physicians in its protective power, and it is not too much to expect that this simple operation will yet be the means of rendering smallpox a disease almost unknown, unless in its modified form.

Vaccination should be performed in the first year of life. In rural districts where there is little danger of exposure to smallpox, it may be deferred till the age of ten or twelve months. In the city, on the other hand, where there is constant intercourse of people, and where contagious diseases are often contracted in ignorance of the time and place of exposure, an earlier vaccination is advisable. Some physicians recommend performance of the operation as early as the age of four or six weeks. The objection to this is, that if erysipelas occur, so young an infant is apt to perish from it, whereas an infant three or four months old ordinarily recovers. For this reason I believe that the most suitable age is about four months for the city infant, in ordinary times; but if smallpox be epidemic, vaccination should be performed at an earlier age. I have vaccinated even the newborn infant when smallpox had broken out in adjoining apartments.

Vaccinia usually extinguishes, for a time, the susceptibility to smallpox. According to Mr. Gintrac, varioloid does not occur within two years in those who have been vaccinated. It may, however, in exceptional instances, occur in a mild form within a few months after vaccination. The protection afforded by vaccination gradually diminishes by time, but it does not probably, as a rule, cease entirely. Varioloid, however, occurring thirty or forty years after a successful vaccination, is apt to be severe, and it may even be fatal, showing that it has been but slightly modified. In other cases, even after so long an interval, the symptoms present a degree of mildness which indicates that the protective power of the vaccination is not entirely lost.

If a second vaccination be practised soon after the scab from the first vaccination has fallen, it will usually produce no result, but in other cases it gives rise to a little redness, swelling, and induration, which show that vaccinia has been reproduced, though in a very mild and insignificant form. It is probable that in these cases varioloid might

also occur by exposure, though with a mildness corresponding with that of the vaccinia. The longer the period after the first vaccination, the greater the number of those in whom a second vaccination is effective, and, as has already been stated, the greater also the liability to the variolous disease, until the system is protected by a second vaccination. A second vaccination should be performed about the sixth or eighth year, and a third between the fifteenth and twentieth years. If smallpox be epidemic, it is proper to vaccinate all who have not been vaccinated within three or four years.

Selection of Virus.

The lymph is preferable to the scab for vaccination, provided that it can be obtained fresh. The scab is more easily preserved, and, therefore, if the lymph and the scab be old, the latter is to be preferred. The lymph should be taken on the fifth day, if the vesicle be sufficiently developed. It may also be taken on the sixth, seventh, or even eighth day, provided that the areola have not formed. The lymph of the fifth day acts with greater energy, though that of the sixth or seventh day is not much inferior. Lymph obtained after the formation of the areola is less efficient, though it may communicate the genuine disease.

There is no mode of vaccination so reliable as the use of lymph taken directly from the arm and immediately inserted—the arm to arm vaccination. Lymph can be preserved for a few days on a flattened surface of whalebone, or the segment of a quill, and if employed within a week, it will usually communicate vaccinia Lymph may be preserved a longer period between two surfaces of glass, but the best way of preserving it is in capillary glass tubes. The end of the tube is placed within the vesicle, and the lymph ascends by capillary attraction. When a sufficient quantity is received, the ends are sealed, by holding them for a moment in a flame. Care is requisite in doing this so as not to heat the lymph, as it is spoiled by a temperature much above the body. When the lymph is used, the ends of the tube are broken, and by blowing gently through it a sufficient quantity is received on the point of a lancet.

If the scab be genuine, it presents a dark brown or mahogany color, and has a circular, oval, or at least a rounded form ; it is firm, or compact, and has a lustre. Soft, yellowish, and irregular scabs are not genuine, and those of a dull appearance, or without lustre, have usually spoiled in the keeping. The scab is best preserved in soft beeswax, which excludes the air, and it should be kept in a cool place. It is the belief of many that the vaccine virus gradually becomes weaker by passing successively through the human system (Condie, *American Journal of the Medical Sciences*, April, 1865), and that therefore different specimens of virus work with different energy, according to the degree of removal from the cow. To what extent this view is correct is not fully ascertained, but, certainly, if the virus employed continue to produce a small vesicle, attended only by a little inflammation. there is reason to believe that the protection which it imparts is less than that from virus which works with greater energy, and it should be exchanged for such.

In New York we are able to obtain at any time lymph directly from the heifer. It has never passed through human blood, for the original lymph came from cattle in one of the provinces of France, where vaccinia was prevailing epidemically. The popular objection to vaccination is obviated by the use of this lymph, but it works with great energy, producing a large pock, and a sore which is often a month in healing. I have found it very reliable, and prefer to use it in ordinary cases.

CHAPTER VI.

VARICELLA.

Varicella, chickenpox, or swinepox, is the shortest and mildest of the eruptive fevers. It is highly contagious, so that few children escape who are exposed to it. Its period of incubation is from fifteen to seventeen days. It is not inoculable, or at least those who have attempted to inoculate with the lymph of varicella have failed. I endeavored to communicate the disease in this way some years ago, but without result. It attacks the same individual but once, and it occurs as an epidemic. It has been thought by some to prevail most immediately before, during, or after epidemics of smallpox, and it has been conjectured that it is a modified form of variola, and hence its name, which signifies little variola. This idea is, however, entertained by few, and it is opposed by the following facts: Varicella may occur after variola, or variola after varicella, without any modification, and the two diseases are very dissimilar as regards gravity of symptoms and duration. The variolous disease, whether smallpox or varioloid, often occurs in the adult; varicella, on the other hand, is a disease of infancy and childhood. I have seen one adult case, which I recall to mind, and Professor Flint states that he has also observed it, but its occurrence at this period of life is rare. Moreover, varicella and variola have been known to occur simultaneously in the same individual. Such a case was reported by M. Delpech, in a memoir published in 1845.

Symptoms.—Varicella usually commences with such symptoms as usher in ordinary mild febrile attacks, namely, headache, languor, chilliness, and sometimes aching in the back and limbs. Fever supervenes, which is usually moderate, the pulse rising perhaps to 100 or 112, and the thermometer showing an increase of temperature, but less than occurs in the other eruptive fevers. These symptoms which precede the eruption are sometimes absent, or are so mild as to escape notice. The fever usually ceases on the second day, but it may return on the following night. The appetite is rarely lost, and most children continue, more or less, at their amusements.

When the above symptoms have continued about twenty-four hours,

the eruption appears first over the trunk and soon afterwards over the face and limbs. It consists of minute disseminated papules, which become vesicular in the course of a few hours. The occurrence of the vesicular stage is nearly simultaneous on all parts of the surface. The vesicles lack the hard indurated base of the variolous eruption, though they are sometimes surrounded by a faint zone of redness. They differ also from the variolous eruption in the absence of umbilication, and in irregularity of shape. Some are small and acuminate, some hemispherical, and of medium size, and others oval or elongated, and of large size. The inflammation is quite superficial, not involving the subcutaneous tissue, and scarcely affecting the deepest layer of the skin.

The vesicles vary in size from the diameter of half a line to that of even three lines. They occasionally give rise to slight itching. On the second day of the eruption, or third day of the disease, they are still fully developed, their liquid contents being nearly transparent. At the close of this day the liquid begins to be somewhat cloudy, and its absorption commences. On the fourth day of the disease desiccation progresses rapidly, and by the fifth the liquid has for the most part disappeared, and a scab results, small, thin, and of a yellowish-brown color. The scabs are soon detached, the redness which indicated their seat disappears, the epiderm which had been raised and removed by the eruption is reproduced in its normal state, and in a few days all evidence of varicella is effaced. A cicatrix occasionally results, but it is due not to the simple varicellar eruption, but to a sore produced from the eruption by the scratching of the child.

The number of vesicles varies considerably in different cases. They are never, so far as I have observed, confluent; but they are sometimes so abundant in young children, that, if the disease were variola, it would be called severe discrete. They occur also on the buccal and faucial surfaces, where they soon break, forming small ulcers.

Diagnosis.—Obviously the only diseases with which varicella is liable to be confounded are such as present vesicles at some stage of their course. From the local vesicular eruptions this disease is diagnosticated by the fact that the vesicles appear on all parts of the surface. It is sometimes mistaken for variola or varioloid, or *vice versa*—a mistake very damaging to the reputation of the physician. The points of differential diagnosis are the symptoms of invasion—severe, and lasting three or four days in the one; mild, and continuing only one day in the other—an eruption passing slowly through its stages from the papulæ, to the pustulæ, umbilicated, with circular, raised, and inflamed base, appearing first on the face and neck, and not till a day later on the legs, in the one disease; while in the other the evolution, shape, and course of the eruption, as described above, are materially different. By proper attention to these distinctive features it is rarely difficult to diagnosticate the two diseases.

The prognosis in varicella is always favorable. It does not, of itself, endanger life, nor seriously incommode the patient; nor does it give rise to complications or sequelæ. The treatment, therefore, is the simplest possible. Mild diet, and a laxative, may be prescribed during the febrile period; but nothing further is required.

SECTION III.

NON-ERUPTIVE CONTAGIOUS DISEASES.

CHAPTER I.

DIPHTHERIA.

Diphtheria is a disease of antiquity, dating back at least as far as the commencement of the Christian era. Aretæus, at the close of the first century after Christ, described the Malum Ægyptiacum as a malady which occurred chiefly among children, and was characterized by a white concretion, spreading over the tonsils, a fetid breath, and in some patients by a return of food through the nostrils, and by great dyspnœa, ending in suffocation. Since the commencement of the sixteenth century, numerous epidemics of it have been observed in Europe and America, and at the present time it is one of the most common and fatal epidemic maladies in both continents, while in many localities, especially in large cities, it is established as an endemic.

Age.—Diphtheria is preëminently a disease of childhood, a large majority of the cases occurring between the ages of two and ten years. Under the age of one year the younger the child the less the liability to it, and it rarely occurs prior to the fourth month. The age of the youngest patient in my practice, so far as I recollect, whose disease was undoubtedly diphtheria, was three months and a few days; but in one instance, I observed upon the fauces of an infant of six weeks, whose brother had just died of diphtheria, a few white specks, like grains of salt, over each tonsil, which disappeared in three or four days, without the occurrence of any marked symptoms, by the application of a solution of chlorate of potassium. Certain physicians, having charge of maternity wards, have observed a disease, occurring in newborn infants, which bears some resemblance to diphtheria, but which, if it be true diphtheria, presents anomalous features. Thus, Dr. W. S. Bigelow reports in the *Bost. Med. and Surg. Journ.* for March 11, 1875, ten cases, occurring between September and December, 1873, in the Boston Lying-in Asylum, all fatal but two. The prominent symptoms and anatomical characters were: dark hue of skin, hæmaturia, pseudo-membranous exudation upon certain mucous surfaces, dark green stools, spleen enlarged and dark, kidneys engorged, and in some of the cases effusion of blood into the pelves of these organs, and along the urinary tract, brownish casts in the renal tubes, etc.

Dr. Bigelow refers to what appears to have been similar cases in one

of the continental asylums, and I have met one case in some respects similar, which I saw with Dr. Ewing, of New York. Malignant diphtheria appeared in a family in West Fifty-third Street, in the middle of October, 1880. The patient, a boy of ten years, died, and the remaining two children, as soon as the nature of the malady was apparent, were sent from the house. Nevertheless, one of these, precisely seven days after the removal, was attacked by diphtheria of the hemorrhagic form, and died in less than one week. Blood escaped from the nostrils, fauces, under the skin in numerous places, causing purpuric spots, and from the kidneys or urinary tract, causing hæmaturia.

The mother, who was at this time in the sixth month of pregnancy, continued greatly depressed by the occurrence, although she was robust, and her general health good. She had been in constant attendance upon her children. Her infant, born three months subsequently to the occurrence of diphtheria in her family (February 6, 1881), was well developed, but it presented a similar hemorrhagic cachexia to that in the second case of diphtheria. Blood escaped from the vessels under the skin, causing blotches and prominences, and from the mucous surfaces. The bleeding was especially persistent and copious from the umbilicus, so that death occurred in less than a week. The mother had at no time any diphtheritic symptoms, yet we know that the diphtheritic poison is subtle and penetrative, producing its peculiar inflammation upon the uterine walls of the parturient woman, even when her fauces are not affected. Nevertheless the etiological relation of diphtheria to cases like the above is uncertain, and can only be determined by more numerous observations, and thorough examination. In the epidemic observed by Dr. Bigelow, so far as appears from the published account, the mothers, and other inmates, were not affected with diphtheria, and this must give rise to grave doubt whether the malady affecting the infants were really diphtheritic. Diphtheria is infrequent after the middle period of life, and old age appears to possess nearly an immunity from it.

Incubation.—It is only in exceptional instances that we are enabled to ascertain the incubative period of diphtheria. I was enabled to fix it very nearly in the following cases which occurred in my practice. A boy of nine years was in the same room, about one hour on Saturday, with a child who had fatal diphtheria. On the following Tuesday, without any other exposure, he sickened with a malignant form of the same disease. Mrs. E. assisted in nursing a fatal case of diphtheria, from November 11 to 13, 1874, after which she returned home, several blocks away. On the evening of the 15th she complained of sore throat, and on the following day the diphtheritic pseudo-membrane was observed over her tonsils. On the 19th the exudation had disappeared, and she was convalescent. On the 20th her sister, residing with her, and who had not been elsewhere exposed, was similarly affected, and after three or four days she convalesced. The only other case in the family, a boy, sickened with diphtheria on December 2. In the first of these cases the incubative period seems to have been from two to four days; while in the last, it was apparently longer. In April, 1876, a little girl died of malignant diphtheria in West Forty-first Street,

New York City. Her sister, aged one year, remained with her from April 14 to 17, when she was removed to a distant part of the city, and placed in a family where there was no sickness, and had been no diphtheria. On the night of April 24, seven days after her removal, this infant was observed to be feverish, and on the following day, when I was called to examine her, the characteristic diphtheritic patch had begun to form over the left tonsil. In April, 1875, two sisters, aged seven and five years, resided with their parents, in a boarding-house, in West Twenty-second Street, New York. A playmate in the same house had symptoms which were supposed to be due to a cold, but which were diphtheritic, when one night severe laryngitis occurred, and ended fatally the same day. The physician who had been summoned, diagnosticated diphtheria, and the two sisters were immediately removed to a hotel. But seven days subsequently, diphtheria commenced in the older child. The younger was then removed to a distant part of the same hotel, but on the sixth or seventh day subsequently she also became affected with a fatal form of the disease. It is seen that the period of incubation in diphtheria, like that in scarlet fever, varies in different cases. It is from two to eight days, with perhaps an occasional case outside these limits.

NATURE.—Diphtheria resembles scarlet fever in certain particulars; in its incubative period, as we have seen above, in its variability of type from a very mild to a malignant form, in the common seat of its inflammations, namely, upon the fauces and nasal passages, in the profound blood-poisoning and prostration in the graver cases, and in the frequent occurrence of nephritis as a complication or sequel. It resembles both scarlet fever and smallpox in the fact that it is communicable both through the atmosphere and by contact or inoculation. It resembles erysipelas in the variableness of its duration, and in the fact that one attack does not protect the system from another. In its etiology it resembles typhoid fever, for it is not only communicable from person to person, but it is produced by foul exhalations, as sewer gases. But while there are certain resemblances, it is distinguished from all these infectious diseases by marked peculiarities.

Diphtheria is primary or secondary. The secondary form most frequently occurs during epidemics of the other infectious diseases, and as a complication of them. Those infectious maladies which are accompanied by inflammation of the fauces and air-passages, are most liable to this complication if they occur in a locality where diphtheria prevails; the inflammations of the mucous surfaces accompanying them being transformed into the diphtheritic. In New York, scarlet fever beyond any other disease appears to furnish the conditions which are most favorable for the occurrence of diphtheria, and if these maladies be epidemic in the same locality, not a few of the scarlatinous patients are affected with diphtheria in the latter part of the first, or in the second week, though the converse seldom happens, that a patient with diphtheria contracts scarlet fever. The other infectious diseases, which are most liable to the diphtheritic complication, are measles, variola, whooping cough, and typhoid fever, the bronchitis of these diseases changing to a pseudo-membranous inflammation.

It is an interesting fact that in a patient suffering from diphtheria, the specific inflammation is apt to occur upon such surfaces as are already the seat of inflammation. A catarrhal inflammation however produced is liable, under the influence of the virus, to become diphtheritic and pseudo-membranous. Thus, if I recollect correctly, four children in the New York Foundling Asylum have had diphtheritic conjunctivitis, occurring upon trachoma, and Billroth remarks "catarrhal conjunctivitis, which is so very common, may become diphtheritic" (*Surg. Pathol.*, translated, page 267). All who have seen much of diphtheria are familiar with instances in which a catarrhal inflammation, as from a burn, blister, or wound, as from tracheotomy, becomes diphtheritic. This general fact, in regard to the nature of diphtheria, and its mode of manifestation, namely, that in one affected by diphtheria the diphtheritic inflammations appear by preference upon such surfaces as are already inflamed, has an important practical bearing. In frequent instances during epidemics of diphtheria, I have known careful and experienced physicians suppose that they were treating catarrhal inflammation of the air-passages, when suddenly indubitable signs of diphtheritic disease occurred, usually with a fatal ending. They were obliged to confess to the friends of the patients that they had erred in diagnosis and prognosis, and their reputation was sometimes seriously compromised. Probably, in a certain proportion of such cases, there was a change of a non-specific catarrhal to a diphtheritic inflammation, such as occurs in scarlatinous angina or rubeolous laryngitis in those who contract diphtheria.

The frequent occurrence of epidemics of diphtheria during the last thirty years, and the great mortality which has attended them, have awakened an interest in this malady which has led to a careful study of its causes and nature. Till recently these inquiries were entirely clinical, but during the last few years a new line of investigation has been followed, namely, that of experimenting on animals, the results being observed by the microscope; and while it has led to the confirmation of facts already ascertained, important discoveries have been made, and more important ones are probably in waiting. Among those who have taken the lead in this new field of investigation are Oertel, Bühl, and Hueter, of Germany. These microscopists, and several other experimenters of equal reputation who uphold their views, believe that they have discovered the cause of diphtheria, with a high power of the microscope, standing, as Oertel says, "on the very borders of the visible."

This discovery is so important, not only in itself, but from the promise which it gives of the results of future research, and from the stimulus which it imparts to such inquiries, that a brief statement of the facts in reference to it cannot fail to be interesting at the present time, when diphtheria is so prevalent and fatal in this city and country. The minute objects which the observers alluded to have discovered in patients affected with diphtheria, and which they suppose cause the disease, are endued with life and motion. They belong to the class of microscopic vegetable parasites which have been designated *bacteria*. The bacteria have been divided by Cohn into four genera, with species; but only two of these, it is thought, sustain a causal relation to diphtheria, namely, the sphero-

bacterium or spherical bacterium, or, as Oertel designates it, the *micrococcus;* and secondly, though in less degree, because less numerous, though coexisting with the other form, and penetrating the tissues with it, the *micro-bacterium*, or rod-like bacterium.

The microscope, in the hands of various observers, has revealed the following important facts relative to diphtheria: In every tissue which is the seat of diphtheritic inflammation, and in every diphtheritic pseudo-membrane, the spherical bacteria occur in immense numbers, accompanied by a smaller number of the other kind. In severe cases, in which the system is infected, they occur also in the blood. Ordinarily, as the symptoms of diphtheria become more grave, a proportionate increase in the number of spherical bacteria can be demonstrated by the microscope. They are found in the discharge from the edges of the wound produced by tracheotomy, performed in the treatment of diphtheritic laryngitis, and upon these edges they multiply rapidly, just before a pseudo-membrane forms. If, upon any surface, which is the seat of ordinary catarrhal inflammation, other vegetable organisms, as the leptothrix buccalis, or oïdium albicans, are present—if diphtheritic inflammation supervene, these organisms diminish and disappear, as if deprived of the required nutriment, and are succeeded by the sphero- and micro-bacteria, which increase in numbers as the specific inflammation extends. On the other hand, when the diphtheritic inflammation abates, these bacteria disappear, and other vegetable forms may succeed. In the very commencement of diphtheria, the grayish-white spots which appear upon the inflamed surface consist entirely of these bacteria, with epithelial cells and mucus, while fibrin and pus appear at a later period, as a result of inflammatory reaction.

These facts having been ascertained, various experiments were made by Oertel, Hueter, Von Trendelenburg, Nasseloff, Eberth, and others, in order to determine more fully the exact relation of the sphero-bacteria and micro-bacteria to diphtheria. These organisms were not found in the croupous membrane produced by the application of a powerful chemical agent, as ammonia, nor upon the inflamed surface underneath the membrane, "although the fibrous exudation afforded a soil which varied little or not at all in its histological and chemical composition from that induced by diphtheria." (Oertel.) The mucous membrane of the air-passages, the cornea and muscles in animals, were inoculated with diphtheritic matter, and these two kinds of bacteria were found to increase rapidly, penetrating the tissues in a short time, and infecting the system. Oertel says: "I have noticed in numerous inoculations that if various bacteria, besides the micrococcus, as, for instance, bacillus, spirillum, and bacterium lineola, were present in the matter to be inoculated, only micrococci (sphero-bacteria) and the bacterium termo (in its most minute forms accompanying them) showed evidence of prolific growth, while all other forms disappeared altogether." Nasseloff and Eberth inoculated the cornea with diphtheritic matter, and found that the sphero-bacteria and micro-bacteria penetrated its layers, forcing them apart, and causing within a few days intense keratitis and the death of the animal by infection of the blood. "In the same way," says Oertel, "according to my experiments, the bacteria spread over

the mucous membrane of the trachea, beset the cellular elements, crowd especially into the young exudation cells, or are taken up by them, and gradually cause their dissolution; they fill the blood and lymph-vessels, and bring about, in a mechanical way, a damming-up of the fluids, and, as a consequence, serous exudation. As they close up the capillary vessels, they occasion stagnation in the blood circulation, which induces disturbance of nutrition in the walls of the capillaries, and even rupture of the same. Muscular fibres, also, which are covered and filled with colonies of micrococci, degenerate and slough; in like manner, in severe cases, immense numbers of bacteria appear heaped up in the uriniferous tubules and Malpighian corpuscles of the kidneys, and occasion there parenchymatous inflammation, capillary embolism of the glomeruli of the kidney, with ruptured vessels and formation of epithelial casts in the tubes. In the lymph and blood streams (compare also Hueter), in long-continued sickness of the animal experimented on, these bacteria also accumulate in masses. They induce, as exciters of decomposition and disorganization of organic nitrogenous bodies, septicæmia, through the vegetative process they undergo, and through their relation to oxygen."

Finally, Erfurth repeatedly inoculated the cornea with a negative result, using for the purpose diphtheritic material from which the bacteria had been so far as possible separated.

The importance of such experiments cannot be too highly estimated. In the opinion of those who have performed them, the conclusion is certain that diphtheria is produced by bacteria, which, coming in contact with the mucous membrane, or the cuticle deprived of its epidermic covering, adhere to it; and these, multiplying rapidly, burrow through the tissues, and entering the vessels, infect the whole system. The reason assigned why diphtheritic inflammation in most cases appears primarily and chiefly upon the faucial and nasal surfaces is, that the air, which contains the germs of the bacteria, constantly passes over these surfaces, and, as regards the fauces, the ingesta also, which may contain them.

But the causes and nature of a disease cannot, in general, be fully elucidated by experiments alone, such as have been detailed. They should be aided or supplemented by clinical observations, and of these, as regards diphtheria, we have had an abundance in New York during the past fifteen years. Clinical observations may modify or correct the theories derived from the results of experiments.

But, notwithstanding the many experiments and observations which have been made, the etiology of diphtheria, as Ziegler remarks, is still in doubt, though it is highly probable that its specific principle is the microörganism mentioned above, which "settles in the tissues" where the specific inflammation occurs, and thence "spreads through the system" (Ziegler). Wood and Formad, who in the employment of the State Board of Health made many experiments in 1882, arrived at the conclusion that micrococci are always present in diphtheria, but they express the opinion that they are the ordinary sluggish micrococci which are endued with "new power and virulence," and that they are the specific principle of diphtheria.

The question whether diphtheria is, in its inception, a local or a constitutional disease has been much discussed. If we accept the plausible opinion that the virus gains admission into the system by lodgement upon one of the exposed surfaces, still clinical facts justify the belief that it quickly enters the system by the lymphatics or bloodvessels, so that the judicious physician will make use of constitutional measures from the commencement of his attendance. It is proper to state that Wood and Formad did not find micrococci in the blood in the mildest cases, but in cases of ordinary severity they were always present, so that, in their opinion, the mildest diphtheria may remain a local malady; but it seems to me that the following facts justify the belief that, as it ordinarily occurs, diphtheria should be regarded and treated as a constitutional malady from the first visit of the physician. If the mildest cases remain local, still all such cases as involve danger are or quickly become constitutional:

1. It is a law in pathology that those diseases which have or may have a long incubative period—say of a week or more—are constitutional.

2. Another fact, which indicates primary blood-poisoning in diphtheria, is observed in certain cases, namely, the *occurrence of severe constitutional symptoms for a longer or shorter time, perhaps for half a day, before the appearance of the usual inflammation.* Thus a girl of five years, having malignant diphtheria, whom I saw in consultation, was carefully examined on the first day of her sickness by the attending physician, and, although he closely inspected the fauces, there was no appearance which indicated the nature of the malady till the subsequent day. In such cases, a sufficient number of which I have observed, there is apt to be complaint of soreness of the throat, or difficulty in swallowing, almost from the beginning of the general symptoms; but the pain and tenderness seem to be in the deeper tissues of the neck.

Again, treatment of the inflammations by the most reliable and efficient antiseptics and disinfectants which we possess, commenced at the earliest possible moment and repeated at short intervals, does not prevent the occurrence of indubitable symptoms of blood-poisoning in cases of a severe type. Thus I have treated every portion of the inflamed surface, so far as it was accessible, every second or third hour, with carbolic acid and other disinfectants, almost from the very commencement of diphtheria, and so thoroughly that any vegetable or animal poison with which the remedies had come in contact would probably have been destroyed, or rendered inert, and yet, except in mild cases, symptoms of diphtheritic blood-poisoning have occurred, and as early and uniformly as if less energetic local measures had been employed. While, therefore, I do not fail to recommend local treatment as calculated to diminish septic poisoning, and relieve the inflammations, I have lost confidence in it as a means of preventing the entrance of the diphtheritic poison into the blood. Its powerlessness to prevent contamination of the blood by the diphtheritic virus is an additional evidence that this contamination occurs early.

3. *The quick succumbing of the system in certain malignant cases* is evidently due to diphtheritic toxæmia. We sometimes observe a fatal

result on the second, third, or fourth day, without any dyspnœa, or sufficient laryngitis to compromise life. Cases of this kind, terminating fatally even in the first day, have been reported. The system is suddenly overpowered by the poison, struck down, as it were, by the profound blood change, while the inflammations are still in their incipiency.

4. Important evidence of the constitutional nature of diphtheria is afforded also by the *state of the kidneys*. No internal organs are so often affected in diphtheria as the kidneys, and on account of their location and anatomical relation, it is evident that the poison first passes through the system before it reaches them. Any clinical or anatomical fact, therefore, which indicates that the diphtheritic virus has reached and affected the kidneys, affords proof that it has penetrated the system, and poisoned the blood. Now the occurrence of albumen, with granular or hyaline casts, in the urine, in cases unattended by dyspnœa, affords proof of nephritis, caused by the action of the poison on the kidneys.

Sir John Rose Cormack, of Paris, in a series of interesting and useful papers relating to diphtheria, published in the *Edinburgh Medical Journal* during 1876, states that albuminuria, and of course the nephritis on which it depends, sometimes begin as early as the first day. My observations confirm this statement, as in the following cases:

Case 1.—L. McD., aged three years, was first visited by me on February 29, 1876. I learned from the parents that she had been feverish during the preceding forty-eight hours, and her urine very scanty. A moment's examination was sufficient to show that the case was one of malignant diphtheria, for the fauces were already nearly covered by the diphtheritic pellicle, the temperature was 103¼°, and the pulse 140. The skin was hot and dry, and there was moderate swelling under the ears, and a muco-purulent discharge from the nostrils. On account of the scantiness of the urine, the amount not exceeding f℥iv-v daily, it was impossible to obtain sufficient for examination till the following day. It was then found to have a specific gravity of 1032, to contain a deposit of urates and hyaline and granular casts, a diminished amount of urea, and a large quantity of albumen. It can hardly be doubted, from the scantiness of the urine, and the large amount of albumen found when the urine was first examined, that albuminuria had been present on the first day.

Case 2.—The following was a similar case: K., aged four years, living in West Thirty-sixth Street, was visited by me in consultation on Jan. 29, 1875. Her sickness had also continued forty-eight hours; her fauces were swollen, and covered with the diphtheritic pellicle, which was dark and offensive; respiration guttural; pulse 120; temp. 101°; she had a free discharge from each nostril; urine scanty, its specific gravity 1030; it contained a small amount of albumen, with casts, and a large amount of urates, with no apparent diminution of the urea. Death occurred on the fourth day.

In such severe cases, in which albumen and casts are found in the urine at the first visit of the physician, there can be little doubt that the nephritis begins nearly or quite as early as the pharyngitis, and therefore, since poisoning of the blood must antedate the renal disease, diphtheria affects the system very early, probably from the occurrence of the first symptoms.

Again there are cases, though not frequent—three I can recall to mind during the last two years in my practice—in which the external manifestations of diphtheria are very mild, even insignificant, and quickly cured, but in which the kidneys are early and severely affected. The occurrence of such cases is best explained on the supposition of an early and profound blood change. The following are histories of the cases alluded to:

The house 229 West Nineteenth Street, New York, is an old wooden structure, and the family, which has occupied it during the last five years, has been three times visited by diphtheria, the first case, that of the oldest child, proving fatal. In February, 1876, one of the children had diphtheria in a moderately severe form. He recovered, and, after my visits had been discontinued, his sister, aged six years, who had had scarlet fever when eighteen months old, became feverish, and complained of her throat. No rash appeared on her skin, and there was apparently no coryza. Inspection of the fauces by the parents revealed a small diphtheritic patch over each tonsil. Although diphtheria was so frightful a malady to this family from their past experience, the case seemed so mild that the parents treated it without medical attendance, by the remedies which had been employed for the boy. A mixture of carbolic acid, subsulphate of iron, and glycerine, was applied to the fauces every third hour, sufficiently often, apparently, to destroy all bacteria or other vegetable or animal organisms with which it might have come in contact, and within two or three days the inflammation of the throat seemed to the parents to be cured. Nevertheless, with this insignificant inflammation of the fauces, so quickly subdued, and with no other apparent inflammation of the mucous surfaces, there was severe internal disease going on as the result of the general infection. The child did not regain her former appetite; she had increasing pallor, although able to play about the house: and, finally, in the third week, when I was called to see her, slight œdema of the face and limbs was observed. Her urine, which was scanty, was found to contain pus and blood corpuscles, albumen, and granular casts, and nearly two months elapsed before, under treatment, it became normal, and her health was restored.

The second case occurred in January, 1878, in West Fifty-first Street. A boy, aged six years, in a family in which diphtheria was occurring, had slight sore throat, which abated in two or three days. It was attended by little or no exudation, and would not have been considered diphtheritic, except for the circumstances in which it occurred, and the subsequent history. Still, the boy remained ill, and fretful, and four days subsequently his urine was found to be very scanty and very albuminous; and three days later death occurred, preceded by total suppression of urine. The last urine passed, which was not more than a teaspoonful, became nearly semi-solid by heat. There had been no scarlet fever in the family.

Cases like the above, in which there is an early and profound systemic infection, with but slight evidence of lodgement of the virus upon the faucial or other exposed surface, are interesting as showing the constitutional nature of the malady, even when the symptoms and visible lesions have extreme mildness.

Diphtheria, as experiments on animals and the histories of many reported cases show, is sometimes communicated by inoculation. Most

frequently, however, the virus is received from an infected atmosphere. The antihygienic conditions in which it originates are well known. Many cases in New York are traced to sewer gases, which have escaped into houses through imperfect plumbing.

When diphtheria reappeared in New York in 1858, after an absence of more than fifty years, some of the first and most severe cases seen by myself occurred in the upper part of the city, along the old water-courses, where, in consequence of street grading, water was stagnant and impregnated with decaying animal and vegetable matter. Though observing and treating diphtheria, both in its epidemic and sporadic form, during the last twenty-five years, I have not observed an instance in which it seemed to be communicated from house to house by the clothing of a third person, as we frequently observe in cases of scarlet fever, and sometimes of measles. When it spreads from house to house, or even from room to room, in the same house, I think that it is almost always by the visits of persons having diphtheritic inflammation. The area of contagiousness of diphtheria is therefore limited to the room in which the patient resides, or to his immediate vicinity.

But it is well known that the sputum of a diphtheritic patient and bits of diphtheritic pseudo-membrane may communicate diphtheria. Experiments indeed show this, as do many observations published in the records of diphtheria. Therefore, caution is required that children be not needlessly exposed to the handkerchiefs or towels employed by a patient, nor to his breath, especially during the act of coughing. We may here repeat that in localities where diphtheria is endemic or epidemic, certain constitutional diseases sustain a causative relation to diphtheria. Thus scarlet fever furnishes the conditions in which diphtheria arises in a house whose sanitary state is apparently good, and when there has apparently been no exposure to a diphtheritic patient. In three instances I have known diphtheria thus originating to become dissociated from scarlet fever, and spread as a primary and independent malady.

Anatomical Characters.—In the commencement of diphtheria we observe redness of some portion of the mucous surface. In most cases it is the faucial membrane which is first affected, and that part of it which covers the tonsils. If there be a preëxisting inflammation of one of the other mucous surfaces, or a portion of the cuticle denuded of its epidermis and inflamed, the specific inflammation is apt to appear primarily upon these parts, with or without its simultaneous appearance upon the faucial surface, a fact to which allusion has been made above.

The inflammation varies greatly in severity and extent. In a mild attack it is often limited to a part of the fauces, and there are few exceptions to the rule that the tonsillar portion is affected, the redness gradually fading away in the healthy membrane beyond. In all except the mildest cases, the whole faucial surface is, in the course of a few hours, involved in the inflammatory process, its mucous membrane is thickened and softened, and its follicles tumefied, and actively secreting. In severe cases the uvula is elongated and enlarged from watery infiltration; the submucous connective tissue also becomes involved to a greater or less extent, and swells; and the submucous lymphatic

glands, especially the tonsils, also swell, and are painful. The color of the inflamed surface is sometimes a deep, bright red, almost like arterial blood; in other cases it is a dusky red, which indicates a vitiated state of the blood. The dusky red hue is more common in secondary than in primary diphtheria; it is also common in the obstructive laryngitis of diphtheria, the color becoming more and more dusky as the obstruction increases.

Within a day, and usually within a few hours, from the commencement of the inflammation, a small slightly raised patch or spot is observed, usually upon the tonsillar portion of the inflamed surface, of little importance, did the disease stop here, but very significant as a diagnostic sign, and as a forerunner of what is to happen. This patch, termed the pseudo-membrane, gradually becomes firmer, and at the same time thicker and broader from fresh exudations underneath, and it has a grayish or grayish-white color. Sometimes different points or patches are observed, which extend and coalesce so that the fauces are almost entirely concealed from view. The pseudo-membrane is closely attached to the mucous surface, which it penetrates, becoming firm, and not easily detached. Attempts to separate it often lacerate the engorged capillaries, producing a free flow of blood. It does not ordinarily attain a greater thickness than one-eighth to one-sixth of an inch. I have seen it, however, not far from one-third of an inch thick. By the microscope we observe numerous micrococci with a small number of rod-like bacteria in the meshes of the exudation. They can be traced through the subepithelial tissues, being adherent to and even incorporated in pus-cells, and entering into and blocking up the minute lymphatics and bloodvessels.

The same pseudo-membrane is often firmer in one part than another, the outer and central portions being more compact and tough for a time than that underneath, which is more recent, and in which there is less fibrillation. After a few days, however, decomposition commences, and then that which was first formed becomes softer than the more recent production. When this occurs, the color of the exudation changes from a whitish or a grayish-white to a dirty brown, and its exposed surface is uneven and jagged from the partial separation of shreds and fibres.

The escape of the liquor sanguinis from the engorged vessels diminishes somewhat the turgescence of the inflamed tissue. If this be considerable, the pseudo-membrane often sinks to the level of the surrounding surface, producing an appearance very much like that of an ulcer, or even of gangrene. Though there is no loss of substance in this stage of the pseudo-membrane, it does, however, often occur, being produced by the presence and contraction of the fibrin with which the mucous membrane is infiltrated. Sometimes the pseudo-membrane has a reddish tinge. This is due to rupture of the capillaries, and the escape of the blood-corpuscles. It occurs in those cases in which the inflammation is intense, and the capillaries are greatly engorged. Sometimes the lower part of the exudation is blood-stained, while the exposed surface has the usual grayish-white hue.

Briefly stated, the exudation of diphtheria is found to consist of fibrin forming a delicate interlacing network, epithelial cells more or

less altered by the inflammatory process, leucocytes, nuclei, mucus, and amorphous matter. Upon the faucial, buccal, laryngeal, and perhaps also nasal surfaces, the pseudo-membrane penetrates the entire mucous membrane, so that no line of demarcation between them can be seen with the microscope. Below the larynx upon the surface of the trachea and bronchial tubes, a distinct line of demarcation exists, as in the croupous exudation, so that the tracheal and bronchial pseudo-membrane can be readily detached, without impairing the integrity of the underlying mucous surface.

The inflamed mucous membrane is not only hyperæmic and infiltrated with serum, but it contains numerous round white corpuscles (leucocytes), which may result in part from proliferation of connective tissue corpuscles, but are believed by most pathologists, since Cohnheim's well-known discovery, to be in great part wandering white corpuscles of the blood, which have escaped through the walls of the bloodvessels along with the fibrin. In the commencement of the diphtheritic inflammation, before the pseudo-membrane forms, we often observe a grayish tinge of the mucous surface, which is due to the crowding of these cellular elements underneath and in the mucous membrane, for these newly formed cells can be traced into the submucous connective tissue. Even where the inflammation remains catarrhal, as it does over certain areas in all cases of diphtheria, this infiltration of the mucous and submucous tissues with cells is common.

During the height of the inflammation, it is astonishing often to see with what rapidity the pseudo-membrane returns, when removed by force. A few hours suffice to restore it as firm and extensive as before the interference. In favorable cases this adventitious layer is detached in a few days, and is either expectorated or swallowed with the ingesta. Its separation is promoted by the secretions underneath, especially by pus, which is formed in abundance between it and the surface on which, and in which it lies. In most cases it does not separate in mass, but disappears, by progressive liquefaction, a little less remaining at each visit till all is detached.

Such are the appearances, character, and history of the pseudo-membrane in this malady. Although its common seat is upon the fauces, and in mild cases it occurs only upon the fauces, nevertheless all the mucous surfaces are liable to be attacked by the inflammation, in consequence of infection of the blood, and therefore in severe cases, and even in cases of moderate severity, we often find the product elsewhere, as well as upon the fauces, and in localities where from its mechanical effect it greatly increases the danger and even compromises life. The mucous membrane of the nostrils, mouth, larynx, trachea, bronchial tubes, œsophagus, stomach, intestines, conjunctiva, vagina, and even the delicate lining of the middle ear, are at times the seat of diphtheritic inflammation, with the characteristic product. In a case which occurred in the Nursery and Child's Hospital of New York, the surface of the stomach was almost completely lined with the diphtheritic formation, so that the function of this organ was apparently nearly or quite abolished. The occurrence of the pseudo-membrane in the nares is common, and is attended by the discharge of thin mucus and pus, but

though inconvenient to the patient, its mechanical effect is not dangerous, except in the nursing infant, in whom it interferes, more or less, with lactation. The thin irritating discharge produces excoriation around the nostrils, and upon the upper lip. I have met only one case of diphtheritic inflammation of the intestines, in which the diagnosis was certain. A physician, in whose family severe diphtheria had just occurred, took what was believed to be typhoid fever. After a long sickness, he expelled, per rectum, about one foot of diphtheritic pseudo-membrane in a cylindrical form, evidently produced upon the intestinal walls. In the subsequent months the patient suffered from constipation, and severe abdominal pains, apparently due to contraction in healing of the large diphtheritic intestinal ulcer. Death finally occurred from this state of the intestines. The formation of the diphtheritic pellicle upon the vulva and vaginal walls is occasionally observed, as in one of the cases related above. Its occurrence upon the uterine surface is very rare, except in the parturient woman, in whom it is said to occur by preference upon that part from which the placenta has been detached.

In mild cases of diphtheria, in which the pseudo-membrane is small, and quite superficial, penetrating but little the mucous membrane, in which it is embedded, there is little danger of septic poisoning. But in grave cases, in which the diphtheritic pellicle is extensive, and deeply embedded, so that the lymphatic and bloodvessels are in immediate relation with its under surface, the conditions in which septicæmia occurs are present as soon as decomposition begins. Therefore septicæmia is properly regarded as a not infrequent and dangerous accident in severe diphtheria, but it is obviously very difficult to distinguish septic from diphtheritic blood poisoning, from the symptoms. Septicæmia is most apt to occur in those cases in which pseudo-membrane has become dark gray, and friable, from decomposition, producing an ichorous discharge and offensive breath, and in cases in which blood escapes from the capillaries underneath.

Absorption of the poisonous substance produces inflammation of the lymphatic vessels, along which it passes, and of the lymphatic glands, which these vessels enter. The adenitis also gives rise to inflammation of the periglandular connective tissue, so that the neck is thickened, hard, and tender. If we examine a gland which is swollen and inflamed by the toxic absorption, we will find that its bloodvessels are congested, and its cells have undergone hyperplasia. The periglandular connective tissue is œdematous, and sometimes infiltrated with lymphoid cell-nuclei and pus-corpuscles.* Capillary hemorrhages are also common in the connective tissue, and micrococci are found in the lymphatic vessels, lymphatic glands, and in the connective tissue.

If death occur from obstruction in the air-passages, the lungs will be found much reduced in size, the anterior superior portions being pale from lack of blood, and perhaps emphysematous, while the posterior and inferior portions have a dark red color, many of the lobules being collapsed, and others not only collapsed or semi-collapsed, but in the commencement of pneumonia. This difference in the state of different parts of the lungs, in those who have died of suffocation in consequence of the presence of the false membrane in the air-passages, receives

partial explanation from the seat of the exudation in the bronchial tubes, for in those who perish from this cause the exudation is found chiefly in such tubes as pass to posterior and inferior parts of the organ, while such as pass to the superior and anterior lobules remain free from it. In some instances, in parts of the lungs the pseudo-membrane can be traced along the minute bronchial tubes into the alveoli, where it forms a network—containing in its interstices pus, and sometimes blood-corpuscles, and more or fewer micrococci. Pneumonia is also a common complication, resulting from downward extension of the bronchitis, or occurring independently of the bronchitis.

The muscular fibres of the heart in diphtheria, as in all acute infectious diseases, are liable to granulo-fatty degeneration, so that they become softer, and have a color which French writers liken to that of new leather or coffee and milk. This degeneration has been observed only in a certain proportion of the more malignant cases, and is far from being uniform. Any portion of the heart may undergo this change. It may occur in the columnæ carneæ, or in the walls of the organ. White fibrinous ante-mortem clots are sometimes seen in the cavities of the heart after death from diphtheria.

The blood in cases of a severe type is usually darker than in health, and the clots soft. After death from diphtheritic laryngitis, it is also dark from excess of carbonic acid in it. The chemical changes which the blood undergoes in diphtheria are little known. MM. Andral and Gavarret found a notable diminution of fibrin in grave infectious diseases, as typhoid fever, puerperal fever, etc., and it is not improbable that the same is true of diphtheritic blood, although the exudation of fibrin is so abundant. M. Bouchut and others have found a marked excess of the white corpuscles in the blood in a considerable proportion of diphtheritic patients, so that, instead of three or four in the field of the microscope, as many as sixty have been counted. M. Sanné writes of diphtheria, "It is necessary to recognize in the dark brown blood an abnormal accumulation of the débris of the red corpuscles, débris of little abundance in the normal state, augmented considerably under the noxious influence of the diphtheritic poison, which has rapidly produced destruction of a great number of globules" (*Traité de la Diphthérie*, page 107, Paris, 1877). Small extravasations of blood in various organs are among the most constant lesions. They have been most frequently observed in the brain and its meninges, the lungs, spleen, and kidneys. In one of the cases which I examined after death in the New York Foundling Asylum, the extravasations in and under the gastric mucous membrane produced mottling as great as that of the skin in measles. The micrococci enter the white corpuscles, and no doubt exert a deleterious effect on their function and vitality.

No notable changes have thus far been observed in the nervous centres, with the exception of the apoplectic foci, and softening of adjacent brain substance, and the congestion present when death has resulted from diphtheritic croup. But certain degenerative changes have been discovered in the peripheral nerves, as well as in the muscles in parts affected with diphtheritic paralysis. Thus, in nerves from a paralyzed palate, certain nerve tubes have been observed nearly or quite destitute

of medullary matter, though this is not common, but many tubes are found to contain fatty granules, the result of retrogressive metamorphosis (MM. Charcot and Vulpian).

The liver does not appear to be seriously engaged or its function compromised. In most acute infectious diseases which are fatal in consequence of blood poisoning, the spleen is apt to become softened and somewhat enlarged, but this does not always occur in diphtheria. It will be recollected from the cases related above that the spleen may not be perceptibly enlarged or softened.

The kidneys of all the internal organs are most frequently affected, as is shown by the common occurrence of albuminuria. Parenchymatous nephritis, with the characteristic hyperæmia and swelling, is the usual form of kidney disease which complicates diphtheria. In the albuminous urine are found hyaline and granular casts. This inflammation may begin early in grave cases, even as soon as the first or second day, but its commencement is ordinarily not till toward the close of the first week or in the second. It occurs in the majority of those severe cases which prove fatal from blood poisoning. Interstitial nephritis has also been not infrequently observed in parts of the kidney.

Symptoms.—In general, in the commencement of an epidemic, diphtheria is more severe and fatal than when the epidemic influence is abating. The prominent symptoms, such as arrest the attention of the friends, are often disproportionate to the gravity of the attack. Striking cases illustrative of this have occurred in my practice, the friends not supposing that there was any serious ailment, and not seeking medical advice till the fatal termination had nearly arrived. The initial symptoms are sometimes mild, such as chilliness or rigors, often slight, and succeeded by moderate febrile reaction, languor, and perhaps more or less headache, pain in the limbs or back, and impaired appetite. Still the patient may continue to walk about as if affected with slight and temporary ailment. Children thus affected frequently attend the schools, and do immense harm in propagating the disease. The symptoms in these mild cases are often like those from a cold, for which light attacks of diphtheria are apt to be mistaken by the friends. With some, in mild as well as severe diphtheria, one of the first symptoms is slight tenderness or a sensation of fulness in the fauces. A distinguished clergyman of the Pacific coast, who fell a victim to this disease, dreamed, a few nights before he complained of illness, that his throat was cut. Doubtless the diphtheritic inflammation had already commenced, so that what seemed a forewarning had a natural explanation. So insidious was the commencement in this case that the disease had advanced beyond all hope of relief when medical advice was first sought. But in most cases, other than those of a very mild type, the commencement is more severe, being attended by a temperature of 102° or 103°, or even 104°, with corresponding heat of surface, thirst, languor, loss or impairment of appetite, tenderness of throat, etc. Delirium as well as eclampsia may occur, but both are rare. The febrile reaction ordinarily abates considerably by the close of the second or on the third day, as I have noticed in many observations.

The symptoms of invasion have less prognostic value in diphtheria

than in most other infectious maladies. We meet cases with a severe beginning, attended by delirium, which terminate in apparently complete restoration to health in less than a week, the presence of the characteristic pellicle upon the fauces and the occurrence of diphtheria in other members of the family rendering the diagnosis certain. On the other hand, a mild commencement sometimes ushers in a fatal form of the disease. This is notably true of those cases in which laryngitis supervenes, as it not infrequently does in cases which begin very mildly.

The fever which ushers in diphtheria usually begins to abate after the second or third day, and subsequently, in grave as well as in benign cases, there may be but little or even no elevation of temperature. The diphtheritic poison does not, therefore, like that of scarlet fever, exhibit any marked tendency to increase the animal heat. Even in profound and fatal blood poisoning in this disease, the thermometer shows the normal, or scarcely more than normal, temperature, so that the inexperienced practitioner may be deceived in his prognosis. On the other hand, a continued elevation of temperature with only moderate angina should lead the physician to examine for some complication, perhaps nephritis.

The tongue is moist, and slightly furred. The patient often vomits in the commencement, and if this symptom cease or be seldom repeated, it is not grave; but vomiting occurring often, so that the food is rejected, and due as it frequently is to uræmia, is not uncommon in severe cases. The appetite varies. Repugnance to food characterizes many of the gravest cases, and, if the child be compelled to take it, it is often rejected by vomiting. There are no notable symptoms referable to the state of the intestines. The stools usually appear normal, except as they are changed by medicines.

The respiratory apparatus is not involved in benign cases in which only the fauces are inflamed. But next to the fauces and posterior buccal surface, the Schneiderian membrane is most frequently affected of all the surfaces, and when the nares are inflamed, and are covered to a greater or less extent by the pseudo-membrane, there is more or less discharge, which may excoriate the upper lip, and cause incrustation around the entrance of the nostrils. This often renders respiration through the nostrils difficult. In cases having this severity there is usually at the same time considerable faucial swelling, so as to cause guttural respiration, which is most marked in sleep. But the most important symptoms pertaining to the respiratory apparatus, occur when the inflammation attacks the laryngeal or laryngeal and tracheal surfaces, constituting diphtheritic croup.

Diphtheritic croup often occurs at the commencement of diphtheria, so as to be and continue to be the predominant inflammation, but in other cases it supervenes after diphtheria has continued a few days. There are many mild cases, which give no anxiety so long as the inflammation remains faucial, but in which the whole aspect is within a day changed by the occurrence of croup, and the condition becomes one of imminent danger. Usually when diphtheritic croup occurs there is a simultaneous if not preëxisting exudation upon the fauces. Occasionally in undoubted diphtheria the diphtheritic pellicle forms only upon

the surface of the air-passages below the epiglottis, while the fauces present merely an inflammatory reddening, and the surface of the nares is either free from disease or only reddened. The reader is referred to the chapter relating to diphtheritic croup.

In New York, as will be seen by the table below, the predominant inflammation in about one-fourth of the cases of diphtheria is the laryngitis.

In addition to the accelerated pulse during the febrile stage and the slow and compressible pulse during the stage of profound blood poisoning, the chief symptoms, pertaining to the circulatory system, relate to the state of the heart, and the altered state of the blood which gives rise to hemorrhages. The ante-mortem heart-clots, the weakened action of the heart from degenerated muscular fibres, the hemorrhages from the altered state of the blood, indicate a very dangerous condition of the circulatory apparatus.

Very little attention had been bestowed upon the state of the kidneys, and the character of the urine in diphtheria, till Mr. Wade, of Birmingham, discovered albuminuria, since which many observations in different epidemics, and localities, have established the fact that albuminuria occurs in a majority of cases of a severe type, and in many cases of diphtheritic laryngitis in which the type is not severe. Two conditions of the kidneys give rise to albuminous urine, namely, nephritis, which is the most common, and venous congestion, which occurs in cases of embarrassed circulation, as in certain cases of diphtheritic laryngitis, and in obstruction from heart clots. The latter is comparatively infrequent.

During the latter part of 1875, and in 1876, prior to August 1, I endeavored to obtain and examine the urine in every case of idiopathic diphtheria, having a clear diagnosis, which came under my notice, both in family practice and in institutions with which I have an official connection. Ordinarily, during the first week of a case, I found that the urine deposited urates on cooling, and that the nitric acid test showed a large relative quantity of urea, but I suspect that this was due to a somewhat diminished quantity of urine. But the occurrence of albumen was of chief interest, and the results of the examinations as regards the presence or absence of this, are recorded in the accompanying table. In most cases the urine was examined several times in the course of the disease, and, if albumen was present, a microscopic examination was also made. In nearly all the specimens which contained albumen—all but three or four—casts, usually granular, but now and then hyaline, and sometimes both kinds in the same specimens, were observed. In those cases of albuminuria which recovered, there were comparatively few casts, or none. If the albumen was abundant, and casts plentiful, the case was usually fatal, though not perhaps till after the lapse of three or four weeks, when death occurred with symptoms of exhaustion, paralysis, or feeble heart-action, sometimes with œdema of lungs supervening suddenly, and, probably, formation of heart clots. The albuminuria, unlike that of scarlet fever, seldom occurred except in the grave cases; and in the majority of instances it did not appear till near the close of the first week, or in the second, and, in a few instances, not till

a later period. Although the albuminuria of diphtheria is much more grave than that of scarlet fever, it has in my practice been attended by much less serous effusion or dropsy, often by none which was appreciable. The urine, although containing a large quantity of albumen, ordinarily had nearly the normal appearance, instead of the smoky or hazy color so common in the albuminous urine of scarlet fever.

I. *Cases attended with the usual membranous exudation upon the fauces, with or without coryza, and without laryngitis or with only catarrhal laryngitis; fifty-eight cases.*

	Died.	Recovered.	Result not stated.	Total.
With albuminuria	13	5	1	19
Without albuminuria	4	27	1	32
State of urine not recorded	3	4	..	7

II. *Cases attended with membranous laryngitis as the predominant inflammation; nineteen cases.*

	Died.	Recovered.	Total.
With albuminuria	4	1	5
Without albuminuria	2	4	6
State of urine not recorded	7	1	8

The mortality of the cases embraced in the above table was probably larger than the average in New York practice, for several of them were seen in consultation, and their type was severe. Those in which the state of the urine could not be ascertained, were usually children so young or so near death that it was impossible to obtain sufficient urine for examination.

It is seen that in New York, where diphtheria is endemic, of 62 cases occurring in the course of about ten months, 24 were attended by albuminuria, and 38 were exempt. In a larger number of cases, of which I have preserved the records since 1876, I think that the proportion of albuminous cases has been about the same, but obviously during epidemics of a severe type the proportion is larger than when the type is mild.

An efflorescence is sometimes observed upon the skin during the time in which the temperature is exalted. It is the erythema fugax of dermatologists, suddenly appearing and disappearing. This eruption, which is so common in the febrile and inflammatory affections of childhood, does not seem to present any peculiar characters in children. But there is another eruption, which I have several times observed, and of which I have preserved a drawing as it appeared in one case, which I have no doubt is due to diphtheritic toxæmia, or to septicæmia occurring in diphtheria. It appears after the sixth or seventh day, in the form of red points or spots, not more than a line in diameter, and interspersed with patches of larger size, and irregular margins, one to two inches in diameter. This roseolar eruption is slightly raised, like that of measles; it disappears on pressure, and, in my practice, has appeared usually in fatal cases. Occasionally extravasations of blood occur in and under the skin, like those in the internal organs. The pallor of the skin which diphtheritic toxæmia produces in the second and third weeks, is known to all who have had experience with this disease.

Diphtheritic *paralysis* is described by some writers as a symptom and by others as a sequel. It usually begins during convalescence in the second or third week after the abatement of the inflammatory symptoms, but sometimes not till a later stage. It may on the other hand appear considerably earlier, during the development of the inflammations, as early as the fifth or sixth day, or even as early as the second or third day from the beginning of the diphtheria (Sanné). When the paralysis begins at an early period it may cease, and reappear later, and in other parts. Its commencement may not be announced by any symptoms apart from the loss of muscular power, but in other cases there is febrile movement with albuminuria. The muscles most frequently affected are those of the pharynx, and upper part of the larynx. The muscles of deglutition are sometimes so involved, that the food and drinks are not swallowed till after several successive efforts, and a part may be returned through the nostrils. A portion of the food sometimes enters the larynx, so as to produce violent coughing. As we observe the dysphagia, it seems as if there must be pharyngitis, which renders deglutition difficult, but on inspecting the fauces we find no evidence of inflammation. The mucous membrane ordinarily appears normal, and the nerves only are affected. The velum palati hangs flaccid and motionless like a curtain; and the relaxed state of the muscles at the entrance of the larynx causes guttural respiration, or snoring in certain cases, which is especially marked during sleep. In severe cases the difficulty of swallowing may endanger suffocation from the lodgement of food in the larynx, and inspire dread of taking food on the part of the child. Tickling, and even pricking the velum fails to induce motion. In some there is only faucial paralysis, but in many the loss of muscular power occurs in other parts also. Whenever it occurs elsewhere, the pharyngeal muscles are also usually involved at the same time. Diphtheritic paralysis may affect the motor muscles of the eye, causing strabismus; the muscles of one side, causing hemiplegia; of the legs, causing paraplegia; or of an arm on one side and leg on the opposite. It does not commence simultaneously in the various muscles which are affected, but in succession, those first affected being for the most part the muscles of the pharynx. In some patients the muscles of the bladder are paralyzed, leading to retention of urine or difficulty in passing it. Paralysis in the limbs is frequently preceded by tingling or a sensation of formication. There is often not a total loss of sensation or of motion in the paralyzed part, but more or less numbness with difficulty rather than impossibility of motion. A few cases have been reported in which the paralysis was almost general, and some believe that they have met cases in which the heart was paralyzed, death occurring suddenly and unexpectedly. Dr. J. B. Reynolds relates a case in the *New York Journal of Medicine*, May, 1860, in which there were not only strabismus, partial paralysis of the limbs, and paralysis of the muscles of the pharynx, so that food was regurgitated, but the head dropped forward so that the chin rested on the sternum.

A majority of those affected with paralysis recover, although few regain complete use of their muscles in less than one month, and many do not till between two and four months.

Defect of vision is an occasional result of diphtheria; some have presbyopia; others myopia; some see double; some are amaurotic; while in others one pupil is more dilated than the other, or both pupils are dilated, and feebly sensitive to light. The impairment or perversion of vision gradually disappears as the vigor of system returns.

Various theories have been advanced in explanation of the occurrence of the paralysis, as that of reflex irritation advocated by Brown-Séquard, that of anæmia, etc. A careful examination of the nervous centres, made in certain fatal cases, has revealed nothing which throws light on its etiology. That the diphtheritic virus causes paralysis by some special action is evident, for there is no other infectious disease which is attended and followed by paralysis so often as diphtheria. The most plausible theory is that recently brought to light by histological examinations, which have shown that the peripheral nerves in paralyzed parts have undergone degenerative changes, as mentioned above, so that under the neurilemma, we observe more or less granular matter, in place of the normal nerve tissue, or lying in this tissue. Among the many anatomical changes which the specific principle produces, those in the peripheral nerves must therefore be regarded as important, since pathological changes in the nerves which supply paralyzed muscles sanction the belief that they sustain a causative relation to the paralysis.

Diagnosis.—In most instances the diagnosis of diphtheria is readily made when the case has continued a few hours, for the characteristic false membrane is observed on inspection of the fauces. The physician is usually at his first visit able to state the nature of the pharyngitis from its appearance. But there are cases which vary from the typical form in which the diagnosis is more or less difficult. The confervoid growth of sprue, when occurring upon the fauces, is sometimes mistaken for the false membrane of diphtheria, but the error of mistaking one for the other in cases which I have met, has been due to hasty and careless examination rather than to any real difficulty in the discrimination. The peculiar product of sprue has but little depth and coherence, and is readily detached without injury to the mucous membrane or its vessels. If there be any doubt, the differential diagnosis can be readily made by the microscope.

Follicular pharyngitis, like diphtheria, commences with sharp fever, which, however, is ephemeral, and is attended with the formation of round white masses in the site of the follicles, usually over the tonsils only. These masses do not occur in patches, like those of diphtheria, except when two or three are in close proximity and unite, but at the same time a sufficient number are discrete to establish the diagnosis. Follicular pharyngitis often occurs in several members of a family at the same time, involves no danger, and is quickly cured. The white masses consist of the inspissated secretion of the follicles mixed with epithelial cells.

Prognosis.—No infectious disease presents greater difference in type or severity. In mild epidemics, with moderate fever, slight faucial swelling, and little extent of the pseudo-membrane, a large majority recover, and would recover even without treatment. Uncer-

tainty of prognosis, of which even physicians of ample experience complain, is largely due to the fact that diphtheria terminates fatally in several distinct ways. Hence while the patient may be secure as regards the more manifest and common conditions of danger, so as to justify a favorable prognosis in the opinion of the physician who attends him, the fatal result may suddenly occur from some unseen and unsuspected cause.

Death in diphtheria may result from—

1st. Diphtheritic blood-poisoning.

2d. Probably, also, from septic blood-poisoning produced by absorption from the under surface of the decomposing pseudo-membrane. But it is difficult to distinguish the constitutional effects of sepsis from those produced by the diphtheritic poison. Septic poisoning is obviously most apt to occur in those cases in which the pseudo-membrane is extensive, and deeply embedded, and its decomposition attended by an offensive effluvium. Cervical cellulitis, and adenitis, which, when severe, cause very considerable swelling of the neck, appear to be often, if not usually, due to septic absorption from the faucial surface, the inflammation extending from the absorbents to the glands and connective tissue. Considerable tumefaction of the neck, therefore, seldom occurs in diphtheria or scarlet fever, without manifest symptoms of toxæmia, and it is to be regarded as a sign of its presence.

3d. Obstructive laryngitis.

4th. Uræmia.

5th. Sudden failure of the heart's action, either from the anæmia, and general feebleness, from granulo-fatty degeneration of the muscular fibres of the heart, which is liable to occur in all infectious diseases of a malignant type, or from ante-mortem heart clots.

6th. Suddenly developed passive congestion and œdema of the lungs, probably due to feebleness of the heart's action, or to paralysis of the respiratory muscles. I have known death to occur apparently from this cause during the period of supposed convalescence, and when the visits of the physician had been discontinued. Thus in a case in my practice, symptoms of œdema pulmonum (moist râles in both sides of the chest, and embarrassed breathing) suddenly occurred nearly one month after the disappearance of the faucial pseudo-membrane and inflammation. The urine, which had contained considerable albumen during the active period of the malady, had for some time shown no trace, or but slight trace, of this principle by the proper tests. By active stimulation these symptoms entirely disappeared in a few hours, and the heart's action seemed normal, unless a little weakened. On the following day the same symptoms reappeared, and death occurred before I was able to reach the house.

That physician obviously is least apt to err in prognosis, who recognizes the fact that patients are liable to perish in any of these different ways, and carefully examines in reference to all the conditions which involve danger. Many physicians, as I have had the opportunity to observe, are remiss in not examining more frequently the urine of diphtheritic patients, for there is often a large amount of albumen in the

urine in diphtheria, indicating a poisonous quantity of urea in the blood, and yet the appearance of the urine to the naked eye is probably normal.

Among the symptoms which render the prognosis unfavorable are, repugnance to food, vomiting, pallor of countenance, with progressive weakness and emaciation from the blood-poisoning; a large amount of albumen with casts in the urine, showing uræmia, to which the vomiting is sometimes, but not always, attributable; a free discharge from the nostrils, or occlusion of them by inflammatory thickening, and exudation, showing that a considerable portion of the Schneiderian membrane is involved, hemorrhage from the nostrils or fauces, and obstructed respiration. In diphtheritic laryngitis, attended by obstructed respiration, a large majority have thus far died, whether treated by the most approved inhalations or by tracheotomy. One, at least, of the above symptoms has been present in most of the fatal cases which I have observed.

Treatment.—Although diphtheria has been one of the most common of the severe infectious maladies in this country during the last twenty-five years, physicians are far from agreeing in reference to the proper mode of treatment. This difference of opinion respecting the therapeutic requirements is due in part to difference in the type of the malady in different localities and epidemics, in part to difference in diagnosis, so that one considers a case to be diphtheritic, which another regards as a non-specific inflammation, but more to the fact that different theories are held respecting the cause and nature of diphtheria. Scarcely any other disease presents such a diversity in type as diphtheria, from cases so mild that nearly all recover, whatever the measures employed, to those so severe that a large proportion die under the best possible treatment; and this difference in type may be observed in cases occurring at the same time in a great city like New York, and even in the cases which two physicians practising near each other may be called to treat. Hence one physician recommends with confidence a medicine or mode of treatment as eminently successful in his hands, of which another speaks disparagingly.

The germ theory, which has been described above, according to which diphtheria is produced by microörganisms, has had a marked influence on the therapeutics of this malady. Acceptance of the germ theory does not require us to believe that diphtheria is primarily local, for these organisms might enter and infect the blood through the lungs, before any symptom occurred, but as it is ordinarily promulgated, we are taught that these organisms alight upon one of the exposed surfaces, usually the fauces, where they excite local inflammatory action, and if not promptly destroyed they soon penetrate the tissues, enter the blood, and establish a constitutional disease. Acceptance of this theory evidently leads to the employment of germicide medicines, the so-called antiseptics, or anti-ferments, externally and internally, to arrest and destroy the vegetable growth, their local use sufficing, according to the theory, in the early stage, when these organisms have passed no further than the surface, but their internal use being required in addition, if the malady has continued longer, and the disease become general. Hence, in proportion as this doctrine came in vogue, carbolic acid, chlorine preparations, bromine, the sulphites, phenic acid, and, as the best representative

of this class of medicines, and most powerful antiseptic, salicylic acid, attained at once prominence as the agents which would be most likely to cure diphtheria, by destroying the cause. A solution of bromine and bromide of potassium having been used with apparent good results in the antiseptic surgery of the army during the late war, has obtained under the influence of this theory some reputation in New York as a remedy for diphtheria, employed externally and internally, and without the aid of other therapeutic agents. A certain number of drops are administered internally every hour, or second hour, properly diluted, and the same medicine undiluted, or with less dilution, is applied to the fauces with a brush at regular intervals.

But experience, if sufficiently extensive, is the safe guide in therapeutics, and internal antiseptic measures have not seemed, so far as my observations extend, to exert any marked controlling effect on the course of diphtheria.

Thus, a child of four years, whose case I was able to follow, took, almost from the beginning of the sickness, a mixture of potassa and iron on the first hour, two grains of quinine on the second hour, and three grains of salicylic acid on the third hour, and this treatment was continued night and day; and yet this child, having from the first taken sixteen grains of quinine, twenty-four of salicylic acid, besides the potash and iron daily, died after eight days with profound blood poisoning, having had many extravasations of blood.

This case, which presented the ordinary history of fatal diphtheria, did not seem to be materially modified by the internal antiseptic treatment. It would apparently have done as well without it. It is but one case, though an average example, and I have not observed any other in which the internal use of antiseptics seemed to produce a curative effect. My knowledge, however, of the bromine treatment is limited to the four children of one family, and to the effects of its use, which have been reported to me by others.

Between December, 1875, and July, 1878, I examined minutely, and preserved records of, 104 cases of primary diphtheria, occurring either in my private practice, or seen by me in consultation, besides observing cases, and witnessing autopsies in the New York Foundling Asylum, where diphtheria was endemic nearly two years. From these observations, and from the many cases which I have since observed, I am persuaded that, in order to secure the best treatment, constitutional and local, of diphtheria, it is necessary that the physician should accept the following propositions:

1st. The specific principle of diphtheria, in all probability, quickly enters the blood, in ordinary cases. And after an incubative period, which varies from a few hours to seven or eight days, produces the symptoms which characterize the disease.

2d. As in vaccinia the system is infected as soon as the vaccine eruption appears, so in diphtheria the blood is infected as soon as the pharyngitis and pseudo-membrane occur. Their intimate relation to the circulatory system, and especially the fact that raising the pseudo-membrane lacerates capillaries, and causes bleeding, prevents our believing otherwise.

3d. The blood poisoning is probably sometimes septic, but as it ordinarily occurs, it is produced by a specific principle peculiar to diphtheria.

4th. Facts do not justify the belief that the system can be protected by antiseptic or preservative medicines administered internally. A quantity of this kind of medicine, introduced into the system, sufficient to preserve the blood and tissues from the action of the diphtheritic virus, would, there is reason to think, be so large as to arrest molecular action, and therefore the functions of organs, and occasion death.

5th. There is no known antidote for diphtheria, in the sense in which quinia is an antidote for malarial diseases, and no more probability that such an antidote will be discovered than for scarlet fever or typhoid fever.

6th. Diphtheria, like erysipelas, has no fixed duration. It may cease in two or three days, or continue as many weeks; but the specific poison acts with more intensity in the commencement than subsequently, and its energy gradually abates. Hence, diphtheritic inflammation, which arises in the beginning of diphtheria, as laryngitis, is more severe and dangerous than when the malady has continued a few days.

7th. The indication of treatment is to sustain the patient by the most nutritious diet, by tonics, and stimulants; and to employ other measures, general and local, as adjuvants, to meet special indications which may arise. The rules of treatment appropriate for scarlet fever, apply for the most part to diphtheria. Local treatment of the inflammations should be unirritating, and designed to prevent putrefactive changes and septic poisoning. Irritating applications which produce pain lasting more than a few minutes, or which increase the area or degree of redness, are apt to do harm, and increase the extent and thickness of the pseudo-membrane.

General Treatment.—This may be conveniently considered under the three heads, food, stimulants, and tonics. All physicians of experience recognize the importance of the use of the most nutritious and easily digested food, and the preservation of the appetite—for the safety of the patient requires that he should retain, as far as possible, his flesh and strength. The more nutritious and easily digested the food, given in sufficient quantity, with the appetite preserved, the less, obviously, the danger of the fatal prostration which so frequently occurs suddenly and unexpectedly in grave cases. Beef-tea, or the expressed juice of meat, milk with farinaceous food, etc., should be administered every two or three hours, or to the full extent, without overtaxing digestion. Failure of the appetite, and refusal to take food, are justly regarded as very unfavorable signs. One objection to the use of the brush, instead of spraying the fauces with the atomizer, is that it is more apt to provoke vomiting, by which nutriment, that is so much required, is lost. In malignant cases of diphtheria, as in scarlet fever of a similar type, patients are sometimes allowed to slumber too long without nutriment. It is the slumber of toxæmia, and should be interrupted at stated times, in order to give food.

Stimulants.—M. Sanné, in his treatise on diphtheria, says: "De tous les antiseptiques donnés à l'intérieur, l'alcool est de beaucoup le plus sûr. Plus l'infection est prononcé, plus il faut insister

sur les composés alcoöliques." He states that Bricheteau reports the history of a patient, who took daily, during diphtheria, a bottle and a half of the wine of Bordeaux, without the least symptom of intoxication or headache. A somewhat similar case was reported to me, in which nearly a bottle of brandy was given in less than twenty-four hours, without any ill-effect, and an apparent good result on the general course of the disease. The same rule holds true in diphtheria as in other acute infectious maladies, that while mild cases do well without alcoholic stimulants, they are required in cases of a severe type, and should be administered in large and frequent doses, whenever pallor and loss of appetite, or of strength and flesh, indicate danger from the diphtheritic or septic infection. It matters little how the stimulant is administered, whether milk-punch or wine-whey, provided that the proper quantity is employed. If given early and frequently in grave cases, as, for example, one teaspoonful every half hour of brandy or Bourbon whiskey, it does seem to have a tendency to render the disease more tractable. But to be instrumental in saving life in malignant cases, it must be given boldly from the start. If there be marked diphtheritic toxæmia when its use is commenced it will not save life, but it may prolong it. Although an advocate of the liberal use of alcohol I cannot regard this agent as a specific. When I commenced serving in the New York Foundling Asylum in May, 1878, the quarantine wards contained four children, between the ages of three and five years, who had been sick a few days with severe diphtheria, and it was evident at a glance that they must soon perish with the ordinary mild sustaining treatment. Quinine, iron, the most nutritious food, and a moderate amount of alcoholic stimulants were being given, and we determined to increase the Bourbon whiskey to one teaspoonful every twenty to thirty minutes, day and night. Nevertheless, whatever the result might have been with the earlier commencement of this treatment, the blood poisoning was now too profound, and one after the other died. That intoxication is so seldom produced in this disease by frequent and large doses of the alcoholic compounds is due partly to the quick elimination of such substances from the system, and in part, probably, to the nature of diphtheria.

In fulfilling the indication for sustaining treatment, the vegetable tonics have been long used, especially cinchona and its alkaloid principle quinia. The compound tincture of cinchona, and the fluid extract, have been used and recommended by physicians of experience; but of vegetable agents, quinia has long been and still is more frequently prescribed than all others. But the doses employed vary greatly in size and frequency, in the practice of different physicians. It is administered in large doses for its antipyretic effect, so that twenty or thirty grains are given daily, and in small doses, as one to two grains every fourth hour, for its tonic effect. That there is nothing antagonistic in the action of quinine to the diphtheritic virus, and that it is beneficial in the same way, and no further, than in other acute infectious diseases, is, I think, generally admitted by the profession. Large and frequent doses apparently produce no amelioration in the severity of the disease, or diminish

the degree of blood-poisoning, as is shown by cases like the following, which are not infrequent during severe epidemics.

C., aged four years, male, was examined by me in consultation, on February 10, 1876. I learned that he had apparently contracted diphtheria from the escape of sewer-gas through a defective trap in the little room where he slept, and that the disease began after midday on February 6th, with fever. At 10 P. M. of the same day, when visited by the family physician, the temperature was 103°, and the fauces were red, but without any pseudo-membrane. Four grains of quinia were ordered to be given every two hours, and ten drops of the tincture of the chloride of iron, with two grains of the chlorate of potassium, to be given three times hourly. On the 7th the exudation covered both tonsils and the half arches; temp. 102½°; evening temp. 100°; pulse 128. 8th. Is playful; pulse 100; has slight swelling of the cervical glands; evening, some extension upward of the pseudo-membrane; has vomiting. 9th. Pulse 144; vomits often. 10th. At 3 P. M. began to grow worse; pharynx and nostrils covered with the exudation. From this time the case rapidly advanced to a fatal termination.

It was impossible at the time of my visit to obtain the urine for examination and death occurred a few hours afterwards. Forty-eight grains of quinia daily, administered from the first day, had no appreciable effect in staying the fatal progress of the malady, had no such effect as would be likely to follow were its action antidotal, or did it tend to prevent or diminish the blood poisoning. As an antipyretic, I am justified in saying from our experience in the New York Infant Asylum and New York Foundling Asylum, that quinine is inferior to salicylate of sodium, both in symptomatic and constitutional fevers; but as it is a tonic, and does not impair digestion, it is to be preferred to any other medicine in diphtheria, when the febrile movement is so great that an antipyretic is needed. Great elevation of temperature, however, seldom occurs in diphtheria after the third or fourth day, for when symptoms of blood poisoning occur the temperature is apt to fall, so that in profound toxæmia it is often not more than 101° or 102°, and the indication for quinine is then not for its antipyretic but tonic action. The following is a prescription for this agent as a tonic for a child of five years.

℞.—Quiniæ sulphat. . . . . ℥ss.
Syr. pruni virginiani;
or,
Elix. tarax. comp. . . . . ℥ij.—Misce.

Give one teaspoonful every two to four hours.

All physicians who are familiar with diphtheria have noticed the pallor, loss of appetite, flesh and strength, which commence before the close of the first week in severe cases, and which are always unfavorable symptoms, indicating, as they do, rapid and progressive deterioration of the blood. The use of iron is at once suggested as the proper medicinal remedy to arrest this blood change, from its known effect in increasing the number of red blood-corpuscles, and the quantity of coloring matter in these corpuscles, and the nutritive elements in the blood. By its effect

on the red corpuscles, which are the carriers of oxygen, it increases the functional activity of organs, and improves the general nutrition. The ferruginous preparations, therefore, hold an important place in the therapeutics of diphtheria. The one which has long stood the test of experience, and is now commonly used, is the tincture of the chloride of iron. It should be given in large and frequent doses, as five drops hourly, to a child of three to five years.

The inflammations, so far as they are accessible, should be treated by local measures, but we may combine with the iron one which exerts a decidedly curative action on buccal and pharyngeal inflammations, which is a solvent of pseudo-membranes, and which, after it enters the system, being largely eliminated from the salivary glands, continues after the dose is taken to have effect on the inflamed surface of the buccal cavity and fauces. This medicine, namely, the chlorate of potassium, has of late years become a domestic remedy, but the laity should be cautioned in reference to its use. It is an irritant to the kidneys in large doses, producing intense inflammatory congestion of these organs and arresting their function. The melancholy fate of Dr. Fountaine more than a quarter of a century since, whose life was sacrificed by an experimental dose of one ounce of this agent, is remembered by the older physicians. A few years since in my own practice a child of about three years, with an active pharyngitis, probably diphtheritic, and a temperature of 103°, was allowed to quench its thirst between evening and morning, by drinking from a small pitcher in which three drachms of chlorate of potassium were dissolved. In the morning I was summoned in haste, and found the surface of the patient cold and blue, and pulse feeble. The urine was totally suppressed, and instead of it a few drops of blood passed from the urethra. Death occurred before night. The chlorate had apparently produced some irritation upon the intestinal surface, but the fatal result was evidently due to the state of the kidneys. A child of three years should not take more than three grains at a dose, and no more than one drachm in twenty-four hours. The following will be found useful prescriptions:

℞.—Tinc. ferri chloridi . . . . . ℥ij.
Potas. chlorat. . . . . ℥j.
Syr. simplic. . . . . ℥iv.—Misce.

Dose, one teaspoonful every hour to two hours for a child of three years. In place of the simple syrup three parts of water and one of glycerine may be employed.

℞.—Tinc. ferri chloridi . . . . . ℥ij.
Acidi sulphurosi . . . . . ℥j.
Potas. chlorat. . . . . ℥j.
Glycerinæ . . . . . ℥ss.
Aq. calcis . . . . . q.s. ad. ℥iij.—Misce.

Dose, one teaspoonful every hour to two hours for a child of three years.

The citrate of iron and ammonia alone, or in combination with carbonate of ammonium, may be given in two-grain doses, dissolved in simple syrup, in place of the above mixture, when the inflammation of the fauces has considerably abated or is moderate; or the beef, iron, and wine of the shops may be given every hour or second hour. If the

patient improve, and the disease begin to decline, the intervals between the doses may be lengthened, but the tonic should not be entirely discontinued until the patient is far advanced in recovery, on account of the dangerous sequelæ which take their origin in an impoverished state of the blood.

Local Treatment.—It is important to keep in mind the purpose for which local measures should be employed, as stated above. It is to reduce the inflammation of the mucous surfaces, and destroy the diphtheritic poison and contagious properties in the pseudo-membrane, and to destroy the septic poison, and prevent its absorption, if any form. Forcible removal of the pseudo-membrane, irritating applications, the use of a sponge or other rough instrument, for making the applications, should be avoided as likely to do harm. The applications should be made either with a large camel's-hair pencil, or, better for most of the mixtures employed, with the atomizer. The hand atomizer, like Richardson's hard rubber, or Delano's, which is of simple construction, while it carries a heavy spray from the curved tube, which is introduced over the tongue, is very useful.

Half a dozen to a dozen compressions of the bulb of the hand atomizer cover the surface of the throat more effectually with the liquid than can be done by several applications of the brush, and it is usually not dreaded by the patient. Diminution in size of the pseudo-membrane under the use of the spray is a favorable sign, but if it do not diminish, its presence can do little harm, provided that it is properly disinfected.

The steam atomizer may also be used, and in some cases it is more convenient than that worked by the hand, but the medicine employed in it is necessarily much diluted by the steam from the boiler, unless it be of such a nature that it can be used in both cup and boiler. The steam atomizer possesses the advantage of producing a steady spray, without exciting or disturbing the patient, so that it can be inhaled even during sleep, but it is best often to supplement its action by the hand instrument. The hand atomizer is less apt to be clogged than the delicate glass points of the steam instrument, and will vaporize a thicker liquid. This is an important advantage, especially in using the lime-water for inhalation in croup, since it can be employed in the hand atomizer even when it presents a milky appearance from the amount of lime.

At a recent meeting of the New York Pathological Society I presented a specimen showing the diphtheritic exudation, and a discussion arose as to what is the safest and most efficient solvent of the false membrane, full and exact knowledge of which is very important, especially for correct treatment of diphtheritic croup. Chlorate of potassium, pepsin, lactic acid, and lime, are solvents of pseudo-membranes, and after the meeting of the Pathological Society Dr. Chadbourne, resident physician of the New York Foundling Asylum, and myself, determined to ascertain experimentally which is the best solvent. We employed reliable liquid pepsin, acidulated with lactic acid, thirty drops to the ounce, for one solvent, and the officinal lime-water for the other. Equal portions of pseudo-membrane, removed from the larynx in a fatal case of diphtheritic croup, were added to the same quantity

of these liquids. The lime-water produced complete solution in about twenty-five minutes, while the lactic acid and pepsin required more time. I have repeated the experiment since, with a similar result, and have employed the lime-water mixed with about one-fourth its quantity of carbonic acid water, but this did not seem to impair materially the solvent power of the lime. This last experiment was made in order to determine whether the carbonic acid, which passes over the pseudo-membrane in each expiration, impaired the solvent action of the lime.

Therefore in the local treatment of diphtheritic pharyngitis, plain lime-water is one of the best solvents of the pseudo-membrane used by the atomizer or gargle, preferably by the former, or one of the following mixtures may be employed:

No. 1.

℞.—Acid. carbolic. . . . . ℥ss.
Aquæ calcis. . . . . ℥viij.—Misce.

No. 2.

℞.—Acid. carbolic. . . . . ℥ss.
Potas. chlorat. . . . . ℥iij.
Glycerinæ . . . . . ℥ij.
Aquæ . . . . . ℥vj.—Misce.

More recent investigations, conducted by Dr. Chadbourne, have shown that liquor potassæ, or liquor sodæ, one part to forty of water, is a still more active solvent of fibrin. For further particulars relating to these investigations the reader is referred to our remarks on the treatment of pseudo-membranous laryngitis.

Employ atomizer every hour or second hour. India-rubber tubing, which does not interfere with the action, should be drawn over the sharp point of Delano's atomizer. In this connection, I would state that the hand atomizer with double bulb is preferable to that with single bulb, as the child tolerates better the steady spray. The advantage of its use is very notable in the treatment of diphtheritic croup.

In most cases of diphtheritic inflammation of the fauces the spray suffices for local treatment, but the following mixture, applied by a large camel's-hair pencil, is also very effectual, immediately converting the pseudo-membrane into an inert mass, and putting a stop to all movements of the bacteria which swarm in it, as I have observed under the microscope:

℞.—Acid. carbolic. . . . . gtt. viij.
Liq. ferri subsulphat. . . . . ℥ij–iij.
Glycerinæ . . . . . ℥j.—Misce.

This may be used two or three times daily, between the spraying, or oftener without the spraying. It is not irritating (such an effect would condemn it), but it is dreaded by most children, on account of the unpleasant "puckering" which it produces, and the pain from the contraction, which sometimes extends to the ear.

That form of diphtheritic inflammation which most imperatively requires local treatment, and in which local measures are of more importance than the constitutional, is obviously the laryngeal. Catarrhal laryngitis sometimes occurs in diphtheria, as I have occasionally

observed in the dead-house, without producing any marked symptoms, but the pseudo-membranous laryngitis of diphtheria is also common, and, as all know, is one of the most dangerous forms of disease. It is treated of elsewhere in this volume.

Diphtheritic paralysis requires the use of strychnine with tonics. I ordinarily employ the elix. phosphat. ferri qui. et strychniæ of the shops. Each drachm of this contains gr. $\frac{1}{60}$ of strychnia, and by dilution with water the proper dose can be administered to a child of any age. Thus, recently, a child aged six years, having paralysis of the muscles of the pharynx, recovered in about one week, by the use of one drachm of this medicine daily, given in four or five doses. I have not found it necessary, in any case which I have observed, to employ electricity, but it is no doubt useful in expediting recovery, especially if the paralysis be in the limbs. The anæmic state which succeeds diphtheria requires the use of iron for several weeks in the paralytic as well as non-paralytic cases.

For the treatment of nasal diphtheria, a mixture like the following should be injected warm into each nostril every two to four hours:

℞.—Acidi boracic. . . . . ʒij.
S dii chloridi . . . . . ʒj.
Aquæ . . . . . Oj.—Misce.

Warm lime-water may also be used for this purpose.

Preventive Measures.—The occurrence of diphtheria in a family necessitates the prompt removal of other children of the family either out of the house or to a distant part of it, and the disinfection of the room, and the handkerchiefs, and other linen, and spittoons employed. The diphtheritic, like the scarlatinous, virus may remain for weeks or months in a locality or apartment. In East Fifty-fifth Street two families resided in a brown-stone house, the sanitary condition of which was apparently good. In December, 1874, diphtheria occurred in one of these families, who occupied the lower floor and the basement, causing the death of two of the children. The other family, in order to escape the danger, immediately removed to another part of the city, where they remained two months, returning home on March 6th. On March 14th and 15th, eight and nine days after the return, their two children, aged $5\frac{1}{2}$ and $4\frac{1}{4}$ years, who had been allowed free access to the room in which the fatal cases had occurred, also took severe diphtheria, one of them dying.

In another family, living in the suburbs of New York, a lady contracted diphtheria from her brother's child, who died of the malady a few blocks distant. Returning home, she occupied a small room, remaining constantly in it, and by prompt treatment was soon convalescent. Her only child, a boy of six years, was excluded from her companionship about one month, after which he was allowed to enter the room, and slept in it. Within a few days, namely, thirty-five days after it commenced in the mother, the diphtheritic patch appeared upon his fauces. In one of the asylums of this city, diphtheria has been prevailing more than a year, the cases occurring mainly in one of the buildings, and with so little break or intermission that it appears that the diphtheritic virus has not been eradicated from one or more of the

wards since the first case occurred. Such instances show the danger of admitting children into rooms where diphtheria has occurred, until a considerable period has elapsed, and thorough disinfection has been employed.

When diphtheria is prevalent, indisposition on the part of a child, and especially febrile symptoms, or defluxion from the nostrils, should at once arrest attention. Although there be no complaint of soreness of the throat, the fauces should be carefully inspected, and if they seem too red, they should be sprayed with one of the mixtures recommended above.

Pertussis.

Pertussis is an infectious disease attended and manifested by a catarrh of the air-passages. This catarrh gives rise to a cough which does not differ, during the inception and in the declining period, from that in an ordinary catarrh, but during the middle period of the malady is spasmodic. Exceptionally the system is so mildly affected that the spasmodic element of the cough is lacking through the whole course of the malady, or is confined to a brief period. This distinctive symptom, namely, the peculiar cough, has been attributed to the irritating and disturbing action of the specific principle on the nerves which control the muscles of respiration. Some attribute it to the impression produced upon the filaments of the pneumogastric, especially upon those of the internal branch of the superior laryngeal nerve, by the mucus which collects in the larynx and trachea, and which is known to contain the contagious principle in abundance. This cough consists in a series of forcible and loud expirations, followed by a noisy and difficult inspiration. Its special character is due to spasmodic contraction of the muscles of expiration, and notably of the small muscles of the larynx so as to produce narrowing or even closure of the aperture of the glottis. Each paroxysm of the cough usually ends, not always, in the expectoration of viscid mucus. With rare exceptions pertussis affects the same individual but once. Rilliet and Barthez report a case of its second occurrence, and West another case. I have attended two adult patients, both women of intelligence, who stated that they had had previous attacks in early life. Pertussis usually prevails as an epidemic, but is occasionally sporadic, at which time its type is mild. It is highly contagious through the breath of the patient, or from exhalations from his surface.

In one instance I was able to ascertain accurately the incubative period of pertussis. Mrs. B., having a cough for two weeks, which was afterwards ascertained to be that of pertussis, came from Boston to a family in New York. She remained with this family from 2 P. M., January 2, 1879, till the evening, when she left the city. During her stay she held and kissed an infant that was previously well, and had never been removed from the floor on which it was born. Pertussis was not at that time prevailing in New York. On the 6th, or four days after exposure, the infant began to cough, and this proved to be the beginning of a severe pertussis.

Age.—Most cases of pertussis are between the ages of one year and eight years, but it occasionally occurs in adults and even old people who have not been attacked previously. It is rare under the age of three months, but through the kindness of Dr. Ewing, of New York, I was enabled to see a newborn infant with pertussis, whose mother had had the disease during the two months preceding her confinement. This infant when fifteen minutes old, and during the washing, had the first convulsive seizure, which appeared to consist chiefly of a spasm of the laryngeal muscles, with temporary suspension of the respiration, and attended by deep lividity of the features, with some frothing from the mouth. These attacks occurred nearly every hour, with intervals of complete cessation of symptoms. The mucus between the lips finally became stained with blood, and death occurred on the third day. The mother, the intelligent wife of a clergyman, believes that the infant had similar attacks before its birth, for she frequently experienced in the last weeks of gestation what seemed to be strong convulsive movements in the fœtus, the duration of which corresponded with that of the attacks in the infant. A similar case is related by Rilliet and Barthez,[1] and another by Keating.[2] These cases throw light on the pathology of pertussis, for they show that the specific principle resides in the blood, and that this disease is therefore general or constitutional, and is not localized on the respiratory surfaces as some have held; or if the specific principle resides in or upon the laryngo-tracheal surface, it must, in some cases, if not in all, infect the blood, else it could not be contracted in the fœtal state.

Causes.—Climate, race, and nationality do not seem to exert any decided influence on the spread of pertussis. Females are somewhat more liable to be attacked than males, and, as we have seen, a large majority of the cases occur between the ages of one and ten years. Letzerich, about the year 1870, supposed that he had discovered the cause of pertussis in a fungus, which, received upon the surface of the air-passages in inspiration, increases rapidly and produces the spasmodic cough by its irritating action, or the irritating property which it imparts to the mucus. In the first stage of pertussis he found only the spores of the fungus, and at a more advanced stage in addition to the spores, he discovered branches of the thallus. He placed mucus holding the cryptogam upon the fauces of the rabbit, and witnessed the production of pertussis in this animal. Recently Burger,[3] of Bonn, states, "that the microörganism of pertussis is visible with a power of 340 to 600 diameters, appearing as little rods of unequal size. With a higher power it is seen that the rods have the biscuit form. The groups of bacteria are irregularly disseminated or disposed in line, and somewhat resemble the leptothrix buccalis. The method of preparation is very simple. A small quantity of the expectoration is pressed between two cover glasses, exposed to the flame of a Bunsen burner to coagulate the albumen; the coloring matter is then added (watery solution of fuchsin, or of methyl violet); it is then washed thoroughly in water, or the coloring

[1] Treatise on the Diseases of Children.
[2] System of Medicine by American Authors; Lea Bros., Philadelphia, 1885.
[3] Berlin. klin. Wochenschrift; London Medical Record, May 15, 1884.

matter removed by washing in alcohol, the bacteria alone remaining colored. These bacilli are not found in any other expectoration; they are so abundant, that it is difficult to contest their action, their frequency is always in direct relation with the intensity of the disease." Dr. Poulet[1] also confirms the statement of a special microörganism in pertussis, from his examinations. But no one has yet employed the test of Pasteur with the supposed pertussis microbe, to wit, cultivation. We will accept as certain, the discovery of this microbe, if it have passed through a series of cultivations, and the disease be reproduced with the last product either in man or in some animal as the rabbit.

Lesions have been discovered in certain fatal cases which have been supposed to throw light on the etiology of pertussis, but which are now known to have been merely coincidences or results of the disease. Such are congestion of the spinal cord and its meninges, hyperæmia of the pneumogastrics, and tumefaction of the tracheo-bronchial glands, which it was claimed produced the spasmodic cough by compressing the recurrent laryngeal nerve.

PATHOLOGICAL ANATOMY.—Catarrhal inflammation of the air-passages is uniformly present. It occasionally occurs on the mucous surface of the nostrils and pharynx, but is often absent from these parts. In the majority of patients the inflammation affects the surface of the glottis and that below the glottis. However, in not a few cases the surface of the larynx and trachea is pale and not swollen, or the inflammatory appearance is limited to a small part, as the ventricles of the larynx, while the mucous coat of the bronchi and their branches is swollen and red, and covered with tenacious mucus. Sometimes certain alveoli are found distended by a thick muco-pus, producing an appearance like minute tubercles.

A common lesion found in the lungs of those who have perished with this malady is emphysema, affecting chiefly the peripheral portions of the upper lobes. It is usually vesicular emphysema occurring from over-distention of the air-cells, but in some instances the air has escaped into the connective tissue, causing interstitial emphysema. According to my recollection of fatal cases, which have occurred from time to time in the institutions of New York, and in which I have made post-mortem examinations, the upper lobes were exsanguine and inflated to nearly the fullest extent possible within the thorax, while other portions of the lungs presented areas of pneumonic, or more or less complete atelectatic solidification. Pneumonia, atelectasis, and small extravasations of blood in the lungs, are, indeed, common lesions. Hyperplasia of the bronchial glands is also common, and hyperplasia has also been occasionally observed of other lymphatic glands, as the mesenteric. An ulcer under the tongue which observers have frequently noticed is now attributed to pressure of the tongue on the lower incisors during the cough.

In fatal cases, small extravasations of blood in or upon the brain are common, as is also passive congestion of the sinuses, veins, and capillaries, meningeal and cerebral, attended with more or less transudation of serum within the ventricles of the brain, and between the meninges.

[1] Le Scalpel; London Medical Record, May 15, 1884

Large dark and soft clots, and occasionally some that are white or yellow, are common in the intra-cranial sinuses, especially if, as often happens, death have occurred in convulsions, which supervened upon the severe spasmodic cough.

Symptoms.—Pertussis consists of three stages: first, that of catarrh of the air-passages; secondly, the stage of spasmodic cough, or, for brevity, the spasmodic stage; thirdly, the stage of decline.

The first period is characterized by the symptoms of coryza and bronchitis, which present nothing peculiar or different from ordinary catarrh of the same parts, unless occasionally the cough be more frequent and teasing. Trousseau has known it to be repeated forty or fifty times per minute. The eyes present a moderately suffused appearance, and there is sneezing, with defluxion from the nostrils, but less than in the commencement of measles. The cough, which commences as soon as the catarrh affects the larynx, is accompanied by little or no expectoration. The pulse and respiration are moderately accelerated, and such other symptoms as commonly accompany catarrh of a mild grade are present, namely, increased heat of surface, thirst, and impaired appetite.

The duration of the first stage varies in different cases. In severe hooping-cough it may last only two or three days, and in mild cases be protracted to five or six weeks. It may be absent especially in very young infants. We have alluded above to the newborn infant, in whom there was no first stage, a glottic spasm occurring soon after birth. The first stage commonly ends in from eight to fifteen days. In fifty-five cases observed by Dr. West its average duration was twelve days and seven-tenths of a day. It is stated above that the first stage in rare instances continues during the entire course of pertussis; at least no spasmodic cough occurs. In two such cases which I now recall to mind, both girls, the inflammatory symptoms abated somewhat after the first few days, and an occasional easy cough remained, like that of simple bronchitis, and it continued during a period corresponding with the ordinary duration of pertussis. The diagnosis would have been doubtful, except for the occurrence of pertussis, with its regular stages, in other children of the same families.

Second Period.—This may commence quite abruptly, but ordinarily its beginning is gradual. While the cough commonly has the character present in the first stage, it is now and then observed to be more severe and spasmodic, especially at night, and when the patient is in any way excited. The spasmodic element increases, so that in the course of a week all doubt as to the nature of the disease is removed.

The severity of the cough in the second stage varies considerably in different cases. It sometimes commences quite abruptly, with little warning, but commonly there is premonition of it, and the child endeavors to repress it. He experiences a tickling sensation in the throat, or median line of the chest, or a feeling of constriction. He leaves his playthings, and rests his head on his mother's lap, or takes hold of some firm object for support; his face has a grave or even anxious appearance, while the pulse and respiration are somewhat accelerated. Immediately the cough begins. It consists in a series of short and hurried expirations, which expel a large part of the air contained in the lungs,

followed by a hurried inspiration, which is difficult and noisy on account of the spasmodic contraction of the laryngeal muscles, and narrowing of the glottic aperture. The sound which accompanies the inspiration, and which is often absent, especially in infants is designated the hoop. The forcible expirations, and difficulty experienced in expelling the air from the lungs on account of the constriction of the glottis, afford explanation of the emphysematous distention of the air-cells in the upper lobes, which we have seen is so common in severe pertussis.

There may be a single series of expirations terminating in the manner stated, but often there are several such series embraced in a paroxysm. The cough commonly ends in the expulsion of frothy mucus from the bronchial tubes, and sometimes in vomiting. During the cough there is temporary arrest of blood in the lungs, leading to congestion in the right cavities of the heart, and throughout the systemic circulation; therefore the face is flushed and swollen, and occasionally hemorrhage occurs under the conjunctiva, or from one of the mucous surfaces. The most frequent hemorrhage is epistaxis. When the cough ceases, the normal respiration is restored, the fulness of the vessels immediately abates; but often puffiness of the features is observed, due to serous infiltration of the subcutaneous connective tissue, and continuing for days or weeks during the period when the cough is most severe. The paroxysm lasts from a quarter to a half or even a whole minute, and in that time, in cases of ordinary severity, there are often as many as fifteen or twenty series of expirations.

At the close of the paroxysm, if there be no complication, the symptoms soon abate; the temperature, pulse, and respiration become normal, and there is no evidence of disease. The cough in the second stage is much more frequent in one case than another. At the height of this stage it is generally more severe if it occur at long intervals than when frequent. During the weeks in which pertussis is most severe, there is, in the average, about one paroxysm of coughing in each hour.

The cough increases in severity till the third week of the second stage, or the thirtieth to thirty-fifth day of the disease, after which it remains stationary for a certain time. It is apt to be more frequent in the night than daytime. Sometimes it occurs while the child is quiet; it may even awaken him from sleep, but it is often also produced by mental excitement or by physical exertion. Anger or fright gives rise to it, and therefore the child is apt to cough when being examined by the physician, or when his wishes are not complied with. The ordinary duration of the second stage is from thirty to sixty days. It may, however, be considerably longer or shorter than this.

The *third stage*, which commences at the time when the spasmodic cough begins to abate, is short, not continuing longer than two or three weeks. A protracted stage of decline indicates some complication. While the sputum in the second stage is mucous and frothy, that in the third stage is more opaque and puriform.

In the third as in the second stage, if there be no complication, the pulse and respiration in the intervals of the paroxysms are nearly or quite natural. Febrile excitement, may, however, now and then occur from trifling causes, or, indeed, without any apparent cause. The digestion and the general health in uncomplicated pertussis remain un-

impaired, with the exception of more or less emaciation, which is apt to occur in all but the mildest cases, in consequence of the frequent vomiting. After complete recovery, it is not unusual for the spasmodic cough to reappear at times, for one or even two years. The cough of ordinary simple laryngitis, or bronchitis, assumes this character.

Complications.—These, like the symptoms, are chiefly of a twofold character, namely, inflammatory and neuropathic. From the nature of the cough in pertussis, it would naturally be supposed that the spasmodic affection which is now designated internal convulsions, and which is characterized by spasm of certain muscles of respiration would be a frequent complication. It does sometimes occur in young children, but it is not common. Clonic convulsions affecting the external muscles are, on the other hand, not infrequent. They occur chiefly in the second stage, when the cough is most severe, and in infancy much more frequently than in childhood. They are apt to be general and severe, or if not of this character at first, to become such. The convulsions commence, in most instances, in or directly after the paroxysm of coughing; but they sometimes occur in the interval when the child is quiet.

Rilliet and Barthez remark: "Almost all infants succumb to this complication, ordinarily in the twenty-four hours which follow the first attack; nevertheless, life may be prolonged during two or three days." (Article *Coqueluche.*) In my own practice this complication usually ended fatally before bromide of potassium and chloral were employed, but with the proper use of these agents it can often be arrested. In the month of June, 1857, I was attending a little girl two years and four months old, who had reached the fifth week of pertussis, when she was seized with general clonic convulsions. The mother, who was requested to keep a record of the number of convulsions, stated that there were twenty in all, occurring within forty-eight hours. They affected both sides, the shortest lasting only three or four minutes, the longest seventy-five minutes. The treatment in this case, which eventuated favorably, will be noticed hereafter.

In those who die of convulsions occurring in hooping-cough, the most constant lesion is congestion of the cerebral veins and sinuses, often with transudation of serum. This congestion is due in part to the cough which precedes the convulsions and in part to the convulsions themselves. At the autopsies which I have made of two infants, who died in hospital practice from hooping-cough, accompanied by convulsions, all the cerebral sinuses were filled with clots, which were generally soft and dark; but in the lateral sinuses clots were found which were light-colored. The light color of a clot, either in a vein or sinus, indicates its ante-mortem formation.

The gravity of the convulsive attack can be ascertained by observing whether the patient readily recovers consciousness. Its return indicates that there is no serious congestion. On the other hand, great drowsiness remaining, or a semi-comatose state, indicates persistent congestion, and, perhaps, even the formation of clots in the sinuses of the brain. Death from convulsions is usually preceded by coma. Occasionally meningeal apoplexy supervenes upon the congestion, and death is immediate.

The most frequent inflammatory complications are bronchitis and

pneumonitis. Inflammation of the bronchial tubes of a mild grade, we have seen, is a common accompaniment of pertussis, but when it extends to the minuter tubes, or becomes so severe as to cause acceleration of respiration, it is, properly, a complication. Both bronchitis and pneumonitis, occurring as complications, are developed, with few exceptions, in the second stage. Bronchitis is accompanied by accelerated respiration and pulse, and increased temperature. The danger is proportionate to the amount of dyspnœa.

Pneumonitis is a less common complication than bronchitis, but it occurs more frequently in pertussis than in any other constitutional malady of early life, excepting measles. The congestion which results and remains in the lung when the cough is frequent and severe, favors the development of pneumonia. The symptoms and physical signs which accompany this inflammation and serve for its diagnosis are the same as in the primary form of the disease, and are described elsewhere. Bronchitis or pneumonia usually moderates the severity of the spasmodic cough, for when the inflammatory element in pertussis increases, the spasmodic abates. On the abatement of the inflammation, however, the cough usually regains its former convulsive character. The fact may be stated in this connection, that any complication or intercurrent disease which is attended by decided febrile reaction, ordinarily renders the cough for the time less spasmodic.

The occurrence of bronchitis or pneumonia is shown by the elevated temperature, acceleration of pulse and respiration, short and frequent cough. These symptoms do not cease so long as the inflammation continues, whereas in uncomplicated pertussis the patient seems nearly or quite well between the coughs. In pneumonia the respiration is accompanied by the expiratory moan, and in both bronchitis and pneumonia there is more or less depression of the infra-mammary region during inspiration. These symptoms, in connection with the physical signs, render diagnosis in most instances easy. Although the general character of the cough is changed, a cough now and then occurs, even when the inflammation is pretty severe, sufficiently spasmodic to indicate the nature of the primary affection. Capillary bronchitis and pneumonia are always serious complications.

Not only is more or less emphysema a common complication of severe pertussis, but bronchiectasis also occurs in certain cases, due to the same conditions. Emphysema is a common lesion in young and feeble infants, even when there is no history of any previous severe disease of the respiratory organs. I have found it one of the most common lesions in infants of feeble constitutions, who die in the hospitals and asylums of New York, but it is usually interstitial and confined to a small part of the upper lobes. It is not accompanied by that general distention of the alveoli and consequent enlargement of the lobes which occur in the emphysema of pertussis. Its chief cause in these feeble and wasted infants appears to be impaired nutrition and change in the molecular condition of the pulmonary tissue. The same condition often occurs in severe and protracted pertussis, and therefore serves as an additional and efficient cause of the emphysema.

The following was a not unusual case of this disease as it occurs in the tenement houses and asylums of New York. At the meeting of

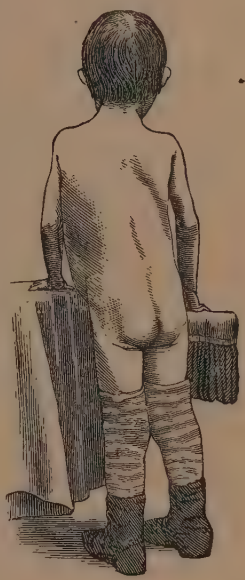
the New York Pathological Society, October 14, 1868, I exhibited emphysematous lungs, removed from an infant who died at the age of nineteen months, at the commencement of the fourth week of pertussis. Death occurred from thrombosis in the lateral sinuses of the cranium, resulting from the severe spasmodic cough, eclampsia, and feebleness of the circulation, as the infant was previously in a reduced state from chronic entero-colitis. At the autopsy the superior lobes of both lungs were found exsanguine, doughy to the feel, and enlarged so as to rise above the level of the other lobes. The resiliency and elasticity of the lung tissue in these lobes were evidently greatly impaired, and their air-cells in a state of over-distention. The other lobes were healthy, except that one of them was the seat of catarrhal pneumonia. In this case there had been no disease affecting the respiratory apparatus, previously to the pertussis, so that the incipient vesicular emphysema was referable to the severe cough and impaired nutrition of the lungs.

Occasionally we meet cases of severe pertussis in which, while there is over-distention of the alveoli of the upper lobes, collapse occurs over a greater or less extent of the lower lobes. Collapse, like emphysema, may continue for weeks or months subsequently to pertussis, and then gradually disappear, but in the following rare case in my experience it was permanent. John O'Neil, aged 5½ years, was brought to the Bureau for the Relief of the Out-door Poor in New York, in December, 1876. He lived in the underground basement of a tenement-house, and was supported by charity, except at intervals, when his father, who was dissipated, could obtain work. At the age of fifteen months he had a glandular swelling on the right side of the neck, which suppurated, and three months later one on the opposite side, which also suppurated. At the age of 2½ years he had bronchitis, the cough of which did not abate till two months subsequently. When near the age of three years he had measles, and the cough from this disease lasted three or four months. In the summer of 1875, or about one year subsequently to the measles, he contracted pertussis, which was severe, but was allowed to run its course without treatment. It lasted four months, never, however, confining him to bed or materially impairing his appetite. One morning about the close of the second month of the malady, the parents first observed depression of the right side of the thorax. This gradually increased for a few weeks and has been permanent. The parents stated that he had never been confined to the house or without appetite except during the week of measles.

Since his recovery from pertussis he has had his usual appetite and general health, but crying or excitement commonly brings on a pretty severe cough. The depression of the thorax examined in front, begins quite abruptly in the line of the left costo-chondral articulations. Circumferential measurement of the left side from the middle of the sternum to the spine, the tape lying a little below the nipple, gives eleven and a half inches, while corresponding measurement of the right side gives seven and a half inches; pulse 136, sounds of the heart normal; respiration 44. On auscultation over the right side of the chest we observed bronchial respiration, and a feeble bronchophony, with perhaps slight vocal fremitus. The accompanying figure is from a photograph by Mr.

Mason, photographer to Bellevue Hospital. My first impression on observing this case was that it was one of unexpanded lung, which had been compressed by a pleuritic effusion, but it is seen that the history points clearly to pertussis as the cause of the deformity. The depression occurred somewhat suddenly when the cough was most severe, and when there was no fever, loss of appetite, or other symptom of pleuritis. The patient had not presented any marked evidence of rachitis, but was decidedly strumous.

Fig. 24.



Pertussis is sometimes complicated by the eruptive fevers. There does indeed seem to be some affinity between it and measles, so that many epidemics of the two have been observed at about the same time. During my term of service in the New York Foundling Asylum, in May, 1878, measles and pertussis prevailed in the wards at the same time. Eighteen of the children, who were having pertussis, contracted measles, and the Sisters, who were very intelligent and faithful observers, and were requested by me to notice the effect of the complication, stated that with few exceptions the severity of the hooping-cough was increased during the continuance of the exanthem. This is contrary to the general belief of the effects of intercurrent febrile diseases.

Diagnosis.—During the period of invasion it is impossible to diagnosticate pertussis. Its nature can only be conjectured from a known exposure or from the epidemic occurrence of the disease. In the second stage, which is characterized by the spasmodic cough, diagnosis is ordinarily easy, and often the parents are able to announce the nature of the disease when the physician is called. Still, a mistake is sometimes made; a spasmodic cough very similar to that of pertussis occasionally occurs in other maladies. Young infants with bronchitis frequently experience great difficulty in the expectoration of mucus, which collects in the air-passages and provokes a suffocative cough. The following facts will aid in making the diagnosis. Bronchitis, accompanied by a suffocative cough, is an acute disease, and the cough occurs at an early period, usually in the first week. It lacks the inspiratory sound or the hoop, and is associated with constantly accelerated respiration and well-marked febrile symptoms, dependent on the inflammation. Moreover, the cough is occasionally suffocative, according to the amount of mucus in the tubes. The spasmodic cough of pertussis, on the other hand, is preceded by the stage of invasion, and it occurs only in the second stage, when the febrile symptoms have abated. Again, the suffocative cough of bronchitis rarely ends in vomiting, which is common in the cough of pertussis.

The only other disease with which there is much likelihood of confounding pertussis is bronchial phthisis. The points of differential diag-

nosis are the following: the one epidemic, and spreading by contagion; the other non-contagious and isolated: the one embraced in three distinct stages, and much shorter; the other chronic, and presenting no stages, but commencing with mild non-febrile symptoms, and progressively becoming more severe: in the one an absence of symptoms in the intervals of the cough, provided that there be no complication; in the other constant symptoms, such as are common in tubercular disease. The previous health, and the presence or absence of a tubercular cachexia, should be considered in determining the nature of the disease. Usually, in bronchial phthisis, the lungs are also affected, so that auscultation and percussion may furnish positive proofs of the nature of the cough.

The attacks of suffocative cough, which are produced by the lodgement of a foreign body in the larynx, or lower down in the air-passages, bear a close resemblance to those of pertussis. The diagnosis can be made by the history, for in the one case there is a preliminary catarrhal stage, and in the other the cough begins abruptly, and usually after the known swallowing of the offending substance, which produces dyspnœa and a spasmodic cough as soon as it enters the larynx. The presence of the body can also be determined in a large proportion of cases by the laryngoscope and auscultation.

Prognosis.—A larger proportion doubtless recover under the better therapeutics of the present time than in former years. According to Hirsch (II., p. 105) 72,900 persons perished from this disease in England and Wales between 1848 and 1855, or one in every forty who died; and Wilde's reports show that it stands fifth as regards mortality among the epidemic diseases of Ireland. In New York City during the half century ending with 1853, 4840 died of pertussis, or one died from this disease in every 76 of deaths from all causes.

As a rule, the older the child the better the prognosis. Young infants may die of suffocation due to the glottic spasm. Eclampsia with extreme passive congestion of the encephalon is a not infrequent complication in children under the age of five years, and it is apt to terminate fatally. It may, however, in my opinion, be averted in most cases by proper treatment. In rare instances death may occur in or immediately after a paroxysm of coughing, in consequence of rupture of cerebral or meningeal capillaries, and the effusion of blood, or from stasis and coagulation of blood in the venous system, especially if convulsions have supervened upon frequent and protracted paroxysms of coughing. Other complications, which are likely to arise under conditions which favor their development, and which greatly increase the danger and render the prognosis unfavorable, are capillary bronchitis, pneumonia, diphtheria, and in the summer season intestinal catarrh. In New York I have noticed that pertussis occurring in the summer is much more fatal if it become complicated with the intestinal catarrh which is an epidemic among infants during that season.

Feebleness of system and antecedent and accompanying chronic disease increase the danger. Pertussis sometimes produces so much emaciation and loss of strength, in consequence of the severity and frequency of the cough, and the repeated vomiting, that intercurrent

diseases which in favorable states of the system would probably end in recovery, are very apt to prove fatal.

I usually inform the family that the patient is doing well, if he seem entirely well between the paroxysms; but if he appear ill, whether with somnolence, fretfulness, fever, loss of appetite, accelerated breathing, or diarrhœa, he is not doing well, and probably has some complication, which requires immediate attention. Sudden deaths occur in the second stage; but deaths from causes and conditions which operate in a gradual, and protracted manner, may occur in the second or third stage.

TREATMENT.—In the catarrhal stage the treatment should be the same as in mild idiopathic catarrh. Demulcent and gentle expectorant measures are required. Care should be taken to employ nothing which reduces the strength or impairs the general health. If there be much bronchitis with accelerated breathing and frequent cough, mild counter-irritation to the chest, and the use of the oil-silk jacket are proper.

Therapeutic measures are chiefly indicated in the second stage, or that of convulsive cough. Proper treatment may control the severity of the cough, and abridge the duration of the second stage, and prevent or control complications. As with most other diseases whose cause and nature are obscure, and which under ordinary circumstances terminate favorably, pertussis has received a great variety of treatment. The enumeration of the medicines and modes of treatment which have had their season of repute, and been employed by intelligent physicians, would occupy too much time. The treatment should vary in some respects according to the case, but a small number of medicines suffices, even in the most severe and obstinate forms of the malady. Knowledge and appreciation of the pathological state in pertussis assist us to the choice of the proper remedies. The specific principle of pertussis produces but little depression of the vital powers. It does not impair the appetite by its direct action, or the nutritive function, nor does it produce those profound blood changes which we observe in scarlet fever and diphtheria. It affects the system injuriously by the severity of the cough, the vomitings and consequent loss of nutriment, and the complications which frequently occur, some of which involve fatal consequences.

Remedies are required which diminish the sensitiveness of the laryngo-tracheal surface, which destroy the specific principle in those parts where the local manifestations of the disease occur, or control its action—that is, in the larynx and trachea. The use of inhalations is at once suggested as most likely to fulfil the indications, since by inhalation the medicine employed is brought into immediate contact with the parts which are chiefly concerned in the disease. In an extensive epidemic occurring among the large number of children in the N. Y. Foundling Asylum a few years since, after trial of various agents for internal treatment, we found that the following mixture seemed to control the disease, diminishing the paroxysmal cough, more effectually than the other medicines employed:

℞.—Acidi carbolic. . . . . ℥ss.
Potas. chlorat.,
Potas. bromidi . . . . . āā ℥ij.
Glycerinæ . . . . . ℥ij.
Aquæ . . . . . ℥vj.—Misce.

To be inhaled from a steam atomizer from three to six minutes every two to six hours, according to the severity of the cough. Since this time, having frequently treated pertussis, it has seemed to me that carbolic acid is the efficient agent in the above formula, and I now employ it in most cases. Carbolic acid appears to have an anæsthetic effect on the laryngo-tracheal surface. It is also an efficient germicide and antiseptic agent, so that, if inhaled frequently, it probably destroys the specific principle, so far as it resides in the mucus and epithelial cells of the air-passages. In my practice it is conveniently employed in the croup kettle. Three teaspoonfuls of the saturated solution of carbolic acid are placed in water enough to cover the bottom of the croup kettle to the depth of two inches, and when this is brought nearly to the boiling point the vapor is inhaled through the tubes every hour or second hour, from three to five minutes. With this treatment infants a few weeks old, as well as those of a more advanced age, have, with few exceptions, passed through the disease without complications, and with paroxysms so mild that the effect of the treatment could not be doubted. But the employment of this agent with an alkali is probably preferable. Dr. Keating[1] recommends the following formula for inhalation:

℞.—Acidi carbolici cryst. . . . . gr. iij.
Sodii biborat.,
Sodii bicarb. . . . . āā gr. xx.
Glycerinæ,
Aquæ . . . . . āā ℥j.—Misce.

An atmosphere loaded with moisture renders the mucus more fluid, and the same result may be in a measure produced by the inhalation of an alkali, as in the above formula.

Other antiseptic agents may be equally beneficial with the carbolic acid. Some of them, whose odor is not so unpleasant, have been used by good observers with alleged benefit, and recommended in the journals. Paulet[2] recommends the evaporation, over a suitable fire, of

℞.—Spirits of thymol . . . . . grammes 10.
Alcohol . . . . . " 250.
Water . . . . . " 750.

Keating also recommends the same agent in the following formula:

℞.—Thymol . . . . . gr. xv.
Alcoholis . . . . . ℥iij.
Glycerinæ . . . . . ℥ss.
Aquæ . . . . . ℥xxxiv.—Misce.

Internal remedies, formerly much used now occupy the second place in the therapeutics of pertussis. Belladonna has been largely employed, since it appears to diminish the spasmodic element in the cough of pertussis. Brown-Séquard, in remarks made before the United States Medical Association, in May, 1860, maintained that the duration of pertussis, so far as its nervous element is concerned, might be abridged to a few days by doses of atropia sufficiently large to cause toxical effect; but in one case, which I saw in consultation, in which one teaspoonful of tincture of belladonna was given by mistake to a

[1] Medical News, February 28, 1885.
[2] London Medical Record, May 15, 1884.

child of about three years, the subsequent cough, though mild, did not lose its spasmodic element. Children require a larger proportionate dose of belladonna than adults, and it can be safely administered in gradually increasing doses until physiological effects are produced, when some mitigation in the cough may be expected. Probably the action of the drug is on the respiratory centres in the medulla and not directly on the muscles of respiration. The effect of belladonna in controlling the spasmodic cough is most marked when physiological symptoms are produced, and some children require larger doses than others. Thus I gradually increased the doses of belladonna to twelve drops for a child of three and a half years who had severe pertussis, without producing the characteristic efflorescence, while smaller doses from the same bottle produced, this effect in older children. Rarely I have discontinued the belladonna on account of diminished flow of urine, which this agent may or may not have produced, and very rarely on account of suddenly developed muscular weakness, which I had reason to think the belladonna caused. This occurred in the case alluded to above, in which twelve drops of the tincture were given, so that the muscles seemed flabby, and the trunk and head were supported with difficulty. The tincture of belladonna is convenient for use, and most of that in the shops is active and reliable. The doses which I ordinarily found to be sufficient when prescribing belladonna for pertussis and which also produced efflorescence, were as follows: to a child of two years three drops, and to one of six or eight years, eight or ten drops, morning and evening. I always, however, commenced with a smaller number, and continued to administer the dose which produced the local effects alluded to, unless the cough were moderated with smaller doses. In the majority of cases I have noticed no decided effect till the rash was produced, when the symptoms improved, the cough becoming less frequent or less severe. By the belladonna treatment the spasmodic stage may not only be rendered mild, but abridged to two or three weeks. In some cases the severe cough begins to yield almost immediately under full doses of this agent, but in other cases its continuance for some days is necessary, with other remedies as adjuvants, before there is any appreciable benefit from its use.

The use of quinine as a remedy for pertussis was first strongly recommended by Binz, who embraced the theory of Letzerich, that this disease is produced by a fungus, upon which the quinine acts injuriously. I have not observed that improvement from the use of this agent, when employed alone—and it has been largely prescribed in the institutions of New York—which I have observed in cases treated at the same time with morning and evening doses of belladonna. Its good effects upon the spasmodic cough are probably due to the fact that it diminishes reflex irritability (Schlakow and Eulenberg). At the same time it acts as a tonic, and improves the appetite, and tends to prevent any depressing effect which might occur from the belladonna. It is beyond question the proper remedy in the frequent cases in which febrile symptoms arise, whether from some complication as bronchitis, pneumonia, or other causes. In ordinary cases a child of five years should take about two grains four times daily, in the elixir adjuvans or other convenient vehicle.

As an antipyretic a larger dose may sometimes be needed. In cases attended by marked elevation of temperature antipyrin may be given in three grain doses to a child of three to five years every third hour, but its depressing and nauseating effects in some instances induce me to prefer quinine.

As the paroxysms are apt to be more severe at night, and the patient consequently be deprived of the required sleep, a medicine is indicated which will procure some hours of rest, and thereby diminish the number of paroxysms. For this purpose the hydrate of chloral is especially useful given in doses of two to five grains, according to the age, and perhaps repeated. It does not seem to me that chloral exerts any marked influence upon the cough; it seems to be useful chiefly in the manner stated, namely, by procuring prolonged sleep.

One of the chief dangers from pertussis we have seen to be the occurrence of great passive congestion of organs, especially of the brain, with the liability to hemorrhages, serous effusion, and eclampsia. This is in great part prevented by the action of the medicines mentioned above, which diminish the severity of the cough, or its frequency. But when there are great and frequent congestions of the nervous centres, producing eclampsia or premonitions of eclampsia, the use of one of the bromine compounds is indicated for its prompt and decided action in averting the danger. Even if the symptoms be not urgent, its tranquillizing effect, and especially its prompt action in diminishing reflex irritability, render it one of the most useful agents in pertussis. If there be sudden twitching of the muscles, marked stupor, headache, or fretfulness, or adduction of the thumbs across the palms of the hands during the cough, I never fail to give the bromide of potassium in sufficiently large and frequent doses, and now eclampsia occurs much more rarely in a case which I treat from the commencement, than in former years.

The complications of pertussis require prompt treatment. Whenever the child feels ill between the paroxysms, he should be carefully examined, and some complication will probably be found which requires treatment. If the bronchitis have increased so as to become a complication, or pneumonia have arisen, the whole chest should be covered with a light flaxseed poultice containing one-sixteenth part of mustard, while quinine and ammonia with alcoholic stimulants are given at regular intervals. Cerebral accidents are best arrested by the warm foot-bath, cold to the head, and by the bromide and chloral.

Diphtheria not infrequently supervenes as a complication in a locality where it is endemic or epidemic, and if mild it is often overlooked. Recently I have seen a case in which diphtheria complicating pertussis had continued four days, without being recognized by the attending physician, the symptoms being attributed to other causes. The diphtheritic patch in these cases appears upon the well-known sore under the tongue, in addition to its occurrence upon other parts. The secondary form of diphtheria requires the same treatment as the primary form.

Hauke, in 1862, published experiments which showed that both carbonic acid and ammoniacal vapors when inhaled increase the cough, while the inhalation of oxygen produced no cough and was agreeable

to the patient. Hence children in close and crowded apartments suffer most severely from pertussis, and those who are taken to parks, or the country, where vegetation absorbs the carbonic acid, not only obtain benefit from the general invigorating influence, but also as regards the cough. The fact that fresh and pure air benefits the cough has indeed long been known, and has influenced practice, for patients are almost universally allowed to be much of the time in the open air, and are taken to the parks and upon excursions. Nevertheless caution in this regard is required, for exposure in wet weather or to sudden changes of temperature is very apt to develop bronchitis or pneumonia.

Prophylaxis.—Pertussis is very contagious, and it appears to be, in nearly all instances, if not in all, contracted by inhaling the breath of the patient. I have never observed a case in which it seemed to be communicated through a third person, and it is not, I think, usually contracted by children living in the same house, if there be no personal contact. There is not, therefore, that urgent need of disinfection, and of caution on the part of the physician and nurse in their subsequent intercourse with healthy children, as in case of the eruptive fevers.

CHAPTER II.

PAROTIDITIS.

Ordinarily, parotiditis, or parotitis, or mumps, has no premonitory stage; but in exceptional cases languor with fever precedes the disease for a few hours. Mumps commences with tenderness in the parotid region, followed soon after by tumefaction. The swelling gradually increases; it fills the depression under the ear, extends forward and upward upon the cheek, and downward to a greater or less extent upon the neck. It has been demonstrated in cases of symptomatic parotiditis, and the same is probably true of the idiopathic disease or mumps (Virchow), that the swelling is due to inflammation of the gland-ducts and consequent œdema of the interstitial tissue. The inflammation is specific, due to a materies morbi in the blood, and hence its decline after a fixed period. It reaches its maximum from the third to the sixth day. The most prominent point at this time is immediately underneath the lobule of the ear. The tumor, which is firm, but slightly elastic, presses outward the lobule. In most cases the skin preserves its normal appearance over the swelling, but occasionally it presents a faint blush. The pressure which movements of the jaw produce on the gland renders mastication and even talking painful. Febrile movement more or less intense occurs, lasting, in ordinary cases, not more than forty-eight hours, but occasionally it is more protracted. Vomiting and epistaxis are sometimes present. The swelling having attained

its maximum size remains stationary a short time, when it begins to decline, and by the sixth to tenth day it has entirely subsided.

In most cases parotiditis is double; it commences on one side, more frequently the left than right, and in from one to four days the opposite gland is involved. In those exceptional cases in which only one parotid is affected, the opposite gland may be the seat of the disease at some subsequent period. It has been estimated that the proportion of unilateral to double mumps is as one to ten.

The total duration of parotiditis is usually from eight to ten days; in the mildest cases it may not be more than five days. The submaxillary glands are often involved in connection with the parotids, and sometimes also the sublingual, although, from their small size and concealed position, their tumefaction escapes notice. Rarely the tonsils are also tumefied. Free perspiration occurs at the commencement of convalescence in certain patients.

The swelling of the parotids sometimes abates suddenly, and in the male the testicle, epididymis, and tunica vaginalis become inflamed; while in the female the mammary glands, ovaries, or the labia majora are the seat of the so-called metastasis. Occasionally these inflammations, which are less frequent in young children than those near the age of puberty, when the sexual organs are becoming more developed, occur without subsidence of the parotid swelling. They cause considerable increase in the fever and constitutional disturbance, but with proper treatment decline in six to eight days, pursuing the same course as the parotid inflammation.

Nature.—Parotiditis is contagious. It is rare in infancy and after the middle period of life, occurring chiefly in childhood, youth, and early manhood. An incubative period of about twelve days was ascertained by me in cases under observation in the Protestant Episcopal Orphan Asylum of this city. The observations of others give a similar result. Parotiditis is a blood disease, having the local manifestation described above, and which is our only means of diagnosis.

Diagnosis.—If the physician has seen but few cases of mumps there is danger that he may mistake the swelling for an inflamed cervical gland, or *vice versa*, but an inflamed cervical gland presents to the finger a hardness almost like that of cartilage, and it is circumscribed or round, and does not invest the ear. These characteristics contrast with the elasticity, seat, and shape of the parotid swelling, which extends forward on the cheek and surrounds and elevates the lobule of the ear. Tumefaction resulting from diphtheritic or any other form of faucial inflammation, or from periostitis affecting the root of the posterior molar, may be detected by examining the fauces and interior of the mouth.

Treatment.—This is very simple. Oakum or carded wool may be bound over the swelling, and the surface occasionally rubbed with sweet oil. Mild laxatives and diaphoretic drinks, such as bitartrate of potassium or lemonade, are useful. If metastasis occur, the new local affection should receive attention. It should be treated in the same manner as if it occurred independently of the mumps, while emollient poultices

or fomentations should be applied over the parotids. The ill-effects of repellant applications in mumps are shown by the following case:

On March 19, 1877, I was requested to see a young gentleman of eighteen years. He had been well till March 14th, when he complained of pain below his ears, and his mother applied a towel, wrung out of cold water, around his neck. On the following day slight swelling was observed under the angle of the lower jaw, on the right side (submaxillary gland), and the cold application was continued. On the 17th the swelling had disappeared, but the fever and headache had greatly increased, so that he was compelled to lie in bed. On the 19th, at my first visit, he had such violent headache, and was so intolerant of light and noise, that I greatly feared that he had acute encephalitis. All swelling under the ears was gone; the left testicle was tender, and beginning to swell; axillary temperature 102°. The cold cloths were removed from the neck and applied to the head, and potass. bromid., gr. xxv, administered every third hour. 20th. Axillary temperature 104°; symptoms unabated and alarming. Ordered six leeches to be applied upon the temples and left groin, and a purgative, and two drops of the tincture of aconite to be given with each dose of the bromide. 21st. Temperature 103°. States that numbness and a pricking sensation which he had felt in both legs during the last forty-eight hours had ceased (possibly from the aconite). 23d. Is convalescent. Has no return of the swelling under the ears, and the orchitis has abated.

SECTION IV.

OTHER GENERAL DISEASES.

CHAPTER I.

INTERMITTENT FEVER.

This is a constitutional malady produced by a miasm which emanates from the soil. I have notes of 36 cases of this disease occurring under the age of $3\frac{1}{2}$ years. Several of these patients were treated in private practice, and the rest in institutions with which I have been connected. In children above the age of $3\frac{1}{2}$ years intermittent fever differs but little from that of the adult, while in those under this age it presents certain peculiarities. Of the 36 cases which I have observed, 19 had the quotidian form, 10 the tertian, 2 the tertian becoming afterward quotidian, 1 the quotidian becoming afterward tertian, while in the remaining 4 cases the form of the disease is not stated. In quotidian ague the malaria has been supposed to act more powerfully on the system, or the system is more susceptible to its influence than in the tertian form, and hence the fact that the quotidian is the prevailing type of ague in tropical regions, where vegetation is luxuriant, marshes extensive, and the heat intense. According to this theory, the feeble resisting power in the system of the infant explains the fact that it has quotidian more frequently than tertian intermittent, although the latter is much more common in the adult in this climate.

Facts demonstrate that infants sometimes receive intermittent fever from their mothers. If mothers during gestation have malarious cachexia, their infants, whether born at full time, or, as often happens, prematurely, are apt to be small, thin, and feeble, and occasionally they have soon after birth distinct paroxysms of the ague. Dr. Stokes related the case of a pregnant woman with ague, who believed that she noticed periodical tremors of her fœtus, but I suspect that she was mistaken as regards the cause, for the paroxysm of intermittent in young children is not ordinarily accompanied by tremors.

The youngest infant in my practice who apparently derived the ague from its mother, and probably through the fœtal circulation, had the following history: Its mother had occasional attacks of tertian intermittent during the two years preceding her confinement, and her baby when one week old was observed to have the same disease, occurring also each second day, the coldness and blueness in the first stage of the paroxysm lasting from half an hour to one hour.

It is not fully ascertained whether a nursing infant may contract intermittent fever by lactation, but if it be admitted that it is sometimes communicated to the fœtus through the maternal circulation, it does not seem improbable that the specific principle occasionally enters the milk as well as other secretions. I have frequently remarked the presence of the disease in nursing infants whose mothers were affected, and in one instance, an infant at the breast, whose mother had the ague, having contracted it in a suburban village, but was since living in a non-malarious part of the city, presented evident symptoms of the disease. Similar observations by Frank, Burdel, and others, do not indeed fully prove the communicability of intermittent fever by lactation, but render it highly probable.

The period of incubation in the infant varies greatly, as in the adult. When the malaria is concentrated and unusually active, or the condition of system is favorable for its reception, the disease may commence soon after exposure. Thus, in tropical regions, travellers exposed for a single night have been known to sicken within twenty-four hours; but in our cooler latitude, a longer incubative period is the rule. In the infant, however, in our climate, intermittent fever often begins in a very short time after exposure, though there may be an incubative period of some weeks. The following have been my observations relating to this point: A. M., female, 8 months old, remained two days on Long Island, in October, 1870, and three days after her return to the city a quotidian commenced. P. S., male, 11 months old, remained three days on Long Island, and a quotidian commenced four days after his return. K., 9 months old, remained on Staten Island one week, and eleven days after his return a tertian commenced. G. K., aged 3 years, remained a day and a night on Staten Island in 1870; three weeks afterward intermittent fever commenced, preceded by a week of languor. A. U., female, aged 2 years and 2 months, had the first paroxysm of a tertian, two and a half weeks after returning from a visit of one week in Hoboken. As there was no malaria in the portions of the city where these infants resided, the incubative periods are nearly ascertained.

Whatever may be the nature of the malarial poison, whether a vegetable cell, as Prof. Salisbury believes, or something else, it often clings tenaciously to the system, and is probably reproduced in it, even under circumstances favorable for its elimination. Thus, at one of my cliniques at Bellevue Hospital Medical College in 1871, a child, 10 years old, was presented, who had had every year for seven years attacks of intermittent fever. The disease was contracted at the age of three years in Harlem, and the subsequent residence of the family had been in a part of the city where there was no malaria.

Symptoms.—In infancy, and especially prior to the age of eighteen months, the symptoms differ in certain respects from those which characterize the malady in the adult, and are universally known. In childhood the symptoms are similar to those in the adult, and need not, therefore, be described in this connection.

In the infant the type as we have seen is quotidian, with now and then a tertian. Advancing beyond the age of eighteen months, we

meet more and more cases of the tertain type, and in childhood it is the common form. I have known the quotidian in the infant, when cured, to reappear a few weeks later as a tertian; but ordinarily it remains quotidian, unless the patient have reached the age at which the tertian type predominates.

The paroxysm in the young infant presents three stages, as in the adult, but while the second, or febrile, is well marked, the first and third are much less pronounced. The patient does not shake (exceptionally, one does even within the first year) in the first stage, but a slight tremor may or may not be observed. The countenance presents a sunken appearance; the lips and fingers are livid, while portions of the surface not livid are pallid, with the goose-flesh appearance, which is, however, less marked than in children of a more advanced age. The blood leaves the surface, which consequently shrinks, while it accumulates in the veins and internal organs; the pulse is feeble, and readily compressed; the surface grows cool from the diminished supply of blood, but the breath is warm, and the internal temperature, so far from being reduced, is elevated two or three degrees. The parents may be alarmed at the sudden sinking of the vital powers, and seek medical advice, but in other instances the first stage is so slight that it passes unperceived, till they have been taught to watch for it, and the second stage first attracts attention.

In the second or febrile stage, which immediately succeeds, the pulse becomes full and rapid, 120 to 130 or 140 beats per minute, and the external as well as internal temperature is elevated as in few other diseases (104°–108°). The face is flushed, surface dry, and head painful, as evinced by the features. This stage lasts about two or three to six or eight hours. The third stage, or that of perspiration succeeds, which terminates the suffering of the patient till the following paroxysm. In infancy the perspiration is not abundant, and in the first half of this period is nearly absent. In the interval of the paroxysm the patient appears well, except a degree of languor.

In twenty-four of the cases of infantile intermittent which I have treated my notes describe the character of the paroxysms. In sixteen of these there was no chill or trembling in the first stage, but blueness and coolness of the extremities and features, and sudden prostration. This stage lasted from ten minutes to one hour. In the eight remaining cases the infants were observed to tremble or shake as in adult cases. The perspiration of the third stage was in nearly all cases, when observed, slight and of short duration, but in some it was not observed.

During the cold stage, passive congestion of the internal organs occurs to a greater or less extent, but the circulation is equalized during the reaction of the second stage. The spleen, whose capsule is distensible, soon enlarges in many patients, in consequence of the frequent and great congestions, constituting the "ague cake." This enlargement is more common in children than adults. Since my attention has been particularly directed to this subject, I have been able to feel the enlarged spleen, by examination through the abdominal walls, in probably one-third of the cases under the age of ten years. This organ returns to the normal size after the ague is cured. From the intimate relation of

the spleen to the composition of the blood, it is evident that the character of this fluid must be affected if intermittent fever be protracted. The blood becomes more and more impoverished, and a state of decided hydræmia supervenes. A few weeks' continuance of the ague suffices to produce decided pallor of the features, and surface generally, and as all watery blood is prone to transudation, such patients not infrequently present more or less œdema of the face, ankles, and other parts. Sometimes, also, especially under unfavorable hygienic circumstances, purpuric spots (purpura hemorrhagica) appear under the skin, affording additional proof of the change which the blood has undergone.

In long-continued cases of malarial disease in the adult waxy degeneration of organs is apt to occur, as well as melanæmia. Pigment cells, flakes, and particles appear in the blood, the coats of the minute arteries, and in various organs, as the spleen, liver, etc. In the child these results are more rare.

Intermittent fever in children, if proper remedial measures are employed at an early period, is ordinarily not dangerous, and is quite amenable to treatment; but that comparatively infrequent and fatal form of it, designated the pernicious, occurs more frequently in children than adults. In New York City, where the type of malarial diseases is mild, I have never met a case of pernicious intermittent in the adult, but I can recall to mind such cases in children, two of them fatal. This form of the fever occurs in a smaller proportionate number of cases in infancy than in childhood, probably because the cold stage is less pronounced. In the pernicious ague the system is overpowered—it does not react in a degree commensurate with the intensity of the disease. The patient enters the cold stage, becomes stupid, and, if not relieved by prompt and efficient measures, passes into fatal coma. A type of the disease, therefore, which would not be pernicious in a robust individual, may be such in one of a broken-down constitution and feeble reactive power. In most cases occurring in children the coma is preceded by eclampsia, which is apt to be general and protracted.

Eclampsia increases the passive congestion of the cerebro-spinal axis already present in this stage, and if not speedily relieved may end in transudation of serum over the surface of the brain, and perhaps meningeal apoplexy, causing fatal coma. This has occurred twice in my practice.

Sometimes in young children the diagnosis of intermittent fever is doubtful, either because the disease has not continued sufficiently long, or there has not been the characteristic paroxysm. The patient may be feverish, and fretful, with anorexia, and evidences of headache, but without the usual distinctive symptoms. I have sometimes in such cases been able to establish the diagnosis by detecting enlargement of the spleen. In examining for the "ague cake," the child must lie quietly on its back, and the fingers, placed midway between the epigastrium and umbilicus, be carried gently but with firm pressure outward in the direction of the spleen, when the anterior edge of this organ will be felt, if it be enlarged. It is impossible to make the examination when the child cries, on account of the contraction of the abdominal muscles.

Treatment.—It is evident that no time should be lost in applying appropriate remedies in a case of infantile ague; for, although the first paroxysm may be mild, the next may be more severe, and attended by danger. Moreover, the sooner the disease is cured, the less liable it seems to be to return. Therefore we prescribe at once the sulphate of quinia or cinchona, one and a half grains of the latter producing the effect of about one grain of the former. Our experience in the children's class in the Outdoor Department has been chiefly with the sulphate of cinchona, on account of its cheapness, and there has yet been no case of ague which it has failed to control. A recent writer has published statistics showing his success in curing intermittent fever by this agent, but nothing in therapeutics is more easy than to cure this disease in our climate by either of the sulphates mentioned. The chief difficulty consists in preventing a return. To an infant of two years I prescribe one grain of sulphate of quinia, or the equivalent of sulphate of cinchona, three times daily, till all symptoms of the ague have disappeared; then twice a day during the subsequent week, and afterward once a day for some days; and finally twice or thrice a week. It is only by the protracted use of the drug in occasional doses that the return of the intermittent can be prevented.

It is important in administering these sulphates to infants to employ a vehicle which will, so far as possible, disguise the bitterness. The vehicle which I prefer for their administration is the elixir adjuvans or elixir tarax. co. The following formula is for a child of three years:

℞.—Quiniæ sulphat. . . . . gr. xij.
Syr. pruni virginiani . . . . . ℥jss.—Misce.

The following is also a good formula:

℞.—Quiniæ sulphat. . . . . gr. xvi.
Ext. glycyrrhizæ . . . . . ʒi.
Syr. rubi. idæi., (Raspberry) . . . . ℥ij.—Misce.

One teaspoonful three to five times daily. The first dose should be given immediately after the fever abates. In this climate two or three days suffice to cure the disease, after which by daily but gradually diminished use of medicine in the manner stated above, the return of the malady is prevented. Protracted cases attended by anæmia require the use of iron in addition to the remedy which is designed to control the disease.

CHAPTER II.

REMITTENT FEVER.

If a physician was to consult the standard treatises on diseases of children in order to ascertain the nature of intermittent fever, he would rise from the perusal with no clear idea of it. One tells us that the remittent fever of children is identical with typhoid fever of adults; another, that it is a gastro-intestinal inflammation; and, finally, Hillier believes that there is properly no such disease, and that the term should be dropped from the nosology of diseases of children. There is, however, a remittent fever of children as well as adults, and much of the confusion which exists in reference to it arises from the fact that writers have not kept in view what constitutes a fever.

Febrile action which has a local cause is not an essential fever, and should not be described as such. It happens that in children a symptomatic remittent fever arises from a variety of local causes, as dentition, intestinal worms, subacute gastro-intestinal inflammation, etc. But all such cases should be excluded from our consideration of remittent fever, as clearly as we distinguish the continued fever of pneumonia or bronchitis from that of typhus or typhoid.

There is an essential remittent fever of children due to malaria. The same conditions which produce intermittent fever do, in a certain proportion of cases, produce a fever which does not intermit, but continues with more or less pronounced exacerbations a certain number of days, when it ceases or becomes intermittent. Those who practise in malarious localities notice a larger proportion of cases of remittent fever among children than adults, because their constitutions are less able to resist the malarial poison, so that an exposure which in an adult would produce milder disease, namely, a tertian ague, frequently causes a quotidian or remittent in the child. In young and feeble infants the proportionate number who have remittent fever is large. Cases, too, are not infrequent in localities not malarious, of a remittent fever occurring more frequently in the spring and autumn than in other seasons. Some of these cases are perhaps a mild type of typhus or typhoid fever, but in other instances the conditions do not appear to be present which ordinarily give rise to that disease, and they do not occur in connection with cases of typhus or typhoid in adults. The cause, though obscure, is apparently atmospheric.

The SYMPTOMS of remitttent fever vary in different cases. The exacerbations and remissions are more pronounced in some than others. Even in those cases in which the fever is due to paludal emanations, and occurs in connection with cases of the intermittent, the febrile movement may be almost uniform, slight exacerbations occurring in the latter part of the day. In other cases the exacerbations and remissions are pronounced, the febrile excitement abating in a perspiration.

Occasionally the fever is higher on each second day. Cephalalgia is common, and in severe cases delirium and stupor are not infrequent. There may be distinct remissions in the beginning, and afterward, for a few days, the fever be pretty uniform, when it again remits or ceases. The tongue is covered with a light fur. Thirst, loss of appetite, a tendency to constipation, scanty and high-colored urine, containing perhaps urates, and a cough due to mild bronchitis, are common symptoms.

When remittent fever is due to marsh emanations, the same anatomical characters are doubtless present as in the adult, namely, blood containing more or less pigmentary matter, enlargement of the spleen, bronzing of the spleen, and, in some cases, of the liver, and sometimes of the brain.

The DIAGNOSIS is not always easy. On the one hand, local diseases with symptomatic remittent fever are to be excluded, and, on the other, typhus and typhoid. The discrimination of it from typhus and typhoid fevers is practically of little moment, but it is a matter of vital importance to make a differential diagnosis between it and the local diseases. I have known one of the acutest diagnosticians and most eminent physicians of New York mistake incipient meningitis for it, a mistake indeed not uncommon. The points involved in differential diagnosis will be considered in our description of the local disease.

TREATMENT.—If we have ascertained by a careful examination that the fever is remittent, and not symptomatic, but essential, there is one remedy which is required in nearly all cases, namely, quinia, or its equivalent, cinchona. Mild febrifuge medicines, with light diet, may be first employed in sthenic cases, in which the pulse is full and strong, and the quinia given when the fever has somewhat abated. The diet should be bland, but nutritious, and the bowels be kept regularly open by citrate of magnesium or other mild aperient. Bromide of potassium or hydrate of chloral may be occasionally employed, as recommended in the treatment of typhoid fever, to produce quietude or sleep, in cases attended by delirium or insomnia. A warm mustard foot-bath and cool applications to the head are useful in such cases.

CHAPTER III.

TYPHOID FEVER.

TYPHUS and typhoid fevers occur in children, but the former is mild and infrequent, rarely occurring except when adults of the same household are affected. It requires little treatment, besides good nursing. Typhoid fever, on the other hand, is not infrequent in children, and, as it presents certain peculiarities prior to the age of puberty, it is

proper to describe it in this connection. This disease is much less common in infancy than in childhood, and in the first half of infancy is believed to be rare. Still, there can be no doubt that many cases in the first years of life are not diagnosticated, being mistaken for subacute and protracted entero-colitis. It is probably more common under the age of six years than is usually supposed, although the younger the child below this age the less frequent does it appear to be; while above the age of six years it is more and more frequent until puberty. In the statistics of Cadet de Gassicourt, embracing 276 children, 3 were at the age of two years, 7 at the age of three years, 8 at four years, 13 at five years, and the number gradually increased in successive years until there were 32, 41, and 42 cases at the ages of twelve, thirteen, and fourteen years.

Causes.—It is now generally admitted that typhoid fever is mildly contagious, and that its specific principle abounds largely in the dejections and excretions of the patient. It is uncertain, whether it is communicable by the breath of the patient, or exhalations from his surface. If it is, it is slightly so, while numerous observations demonstrate its communicability through the use of night-stools or privies which contain the evacuations.

Many cases are on record, in which typhoid fever was contracted from drinking water which was polluted through drainage by the stools of typhoid patients. Epidemics of considerable extent and severity have been traced to this cause. This disease occurs more frequently in the autumnal than in the other months. Observations show that typhoid epidemics are most frequent and severe after protracted hot weather, attended by a scanty rainfall, and diminished water-supply. The most extensive epidemic which I have observed in New York City, affecting largely children, occurred after the protracted hot weather of 1882, in which there was great scarcity of Croton water, and the proper flushing out of the waste pipes therefore impracticable. To the noxious effluvia engendered in the tenement houses under such conditions the prevalence of the fever seemed to be largely attributable.

It is an interesting fact that typhoid fever is rarely contracted directly from a patient provided that his stools and soiled linen are promptly disinfected and removed. The virulence of the poison contained in the stools appears to increase after their evacuation; hence the great virulence which they acquire hours after they have been removed from the sick room, and have contaminated the drinking-water.

There is little doubt also that typhoid fever originates *de novo*, caused by the miasm produced by decaying animal or vegetable matter. Numerous cases have been observed in which it originated from defective sewerage, or decaying vegetables in cellars, in localities in which no case had previously been observed. The germs of the disease when it originates under such circumstances may probably be received into the system by inspiration and in the ingesta. The use of well-water which is contaminated with sewer drainage has been repeatedly known to produce it. It has even been traced to impure water used in rinsing milk-cans which contaminated the milk, and to impure ice which contained the subtle specific principle. Boys are more frequently attacked

than girls; according to some statistics, in the proportion of three to one. Deterioration of the health from general causes increases the liability to be attacked. On the other hand, those having tuberculosis, carcinoma, heart disease, and probably certain other visceral lesions, are more apt to escape than those in health.

Klebs believes that he has discovered the specific principle of typhoid fever in a microörganism which he designates the *bacillus typhosus*. It occurs in the form of little rods, each containing a spore at the centre and often one at the end, which spores form new bacilli. He believes that the bacilli enter the system both by the respiratory passages and alimentary canal.[1] He found numerous bacilli of this kind in Peyer's patches. Eberth has also found rod bacteria in the intestinal mucous membrane, mesenteric glands, and spleen in typhoid fever, which appear to vary from other rod bacteria by a difference in staining. In seventeen cases these bacilli were found in six, and not found in eleven.[2] Wernich, on the other hand, believes that the rod bacteria of Klebs and Eberth are the bacteria subtilis common in the large intestine, which have undergone further development, acquired new properties, and perhaps have become the cause of disease.[3] It is evident that it is still very uncertain whether the specific principle of typhoid fever has been discovered. The test of cultivation, and the propagation of the disease from the cultivated microbe, are lacking.

Anatomical Characters.—Since typhoid fever is a constitutional disease, we would expect to find early and important changes in the blood. No alteration, however, has been discovered in this fluid peculiar to typhoid fever. The amount of fibrin is diminished as in most of the essential fevers, and its coagulation is feeble, forming, when the blood stands, soft, small, and dark clots. When the fever has continued for some time, a state of anæmia more or less decided supervenes, in which the amount of albumen and blood-corpuscles is diminished. Although there are often decided symptoms referable to the nervous system, no constant changes have been discovered in the brain or spinal cord. The changes observed in them when death has occurred in the course of typhoid fever have been for the most part due to other causes. It is different with the respiratory system. After the first week of typhoid fever bronchitis is almost as constant as inflammation of the fauces in scarlet fever, and accordingly we find in fatal cases redness and thickening of the bronchial mucous membrane, which is covered with a viscid and ordinarily scanty secretion. Hypostatic congestion of the lungs, with more or less œdema, and in severe and enfeebled cases hypostatic pneumonia, are not uncommon. In the bronchitis and state of feebleness we have the causes of pulmonary collapse, and this lesion is not infrequent over limited portions of the lungs, especially if the bronchitis affect the smaller tubes.

The lesions occurring in the digestive system are important. The mucous membrane of the small intestine is more or less injected, and at an early period, even by the second or third day, the patches of Peyer, solitary glands, and at the same time the mesenteric, begin to enlarge.

[1] Phil. Med. Times, Dec. 3, 1881. [2] British Med Jour., Nov. 26, 1881.
[3] See article on Typhoid Fever, System of Practical Medicine, 1885, Lea Bros.

It has been stated by high authorities that the enlargement is due to infiltration with a peculiar substance, which has been termed the typhus material. I have made microscopic examination of these glands in typhoid fever of the adult, and have found a considerable increase of the small round granular cells of which they are composed. I do not, therefore, doubt that the enlargement is due mainly to hyperplasia of the cellular elements of the glands, though there is probably infiltration to a certain extent of inflammatory products between the cells. The mucous membrane over the glands undergoes inflammatory thickening and softening. In the adult, sloughing of this membrane is frequent, with the disintegration of the glands and their elimination into the intestines, producing ulcers, small and circular, corresponding with the site of the solitary glands, large and oval or irregular, corresponding with the site of the agminate. Disintegration of these glands and the formation of ulcers are less frequent in children than in adults. In the adult who recovers, the mesenteric glands, and those of the solitary and agminate which are not destroyed, return to their normal state by fatty degeneration, liquefaction, and absorption of the redundant cells. In the child this is the common result, instead of sloughing and disintegration, as regards both the solitary and agminate glands, and uniform result as regards the mesenteric, and I may add bronchial glands, which are also in a state of hyperplasia. The absence of ulceration or its slight extent affords explanation of the fact that intestinal perforation is very rare in children.

The spleen gradually enlarges, often to twice the normal size, has a dark red color, and is softened. Enlargement of the spleen possesses great diagnostic value in those cases in which the diagnosis is obscure. For while very similar intestinal lesions may occur in chronic enterocolitis, the coexistence of these lesions with the splenic enlargement and softening shows the constitutional nature of the malady.

In cases which are severe, and which present a decidedly adynamic type, the muscles become soft and flabby, the action of the heart is feeble, and more or less passive congestion of the viscera results. In such cases congestion of the kidneys and albuminuria are not infrequent.

Incubative Period.—As in scarlet fever and diphtheria, the incubative period in typhoid fever varies. In three cases detailed by Griesinger, the fever began twenty-four hours after exposure. In a school at Clapham twenty out of twenty-two boys sickened, according to Murchison, within four days after exposure. Authenticated cases of a longer incubative period are on record, so that Murchison believed that it is commonly about two weeks, and William Budd that it is in most instances from ten to fourteen days, but cases have occurred in which it seemed to be as long as twenty-eight days.[1]

Symptoms.—Typhoid fever has a prodromic stage of a few days, sometimes of a week or more, in which the child appears languid, indisposed to play, and has little appetite, but complains of no pain unless occasional slight headache, and has no symptom which would lead the friends or even physicians to suspect the grave nature of the disease which impended. By and by a slight fever occurs.

[1] See article Typhoid Fever, System of Practical Medicine, 1885, Lea Bros.

In exceptional instances typhoid fever begins with a chill followed by pronounced fever. It occurred in three of the fourteen cases observed by Prof. Jacobi, in Bellevue Hospital. This was a larger proportion of cases with such commencement than I observed in the epidemic of 1882 or have since observed, but the cases in Bellevue seem to have been unusually severe, since five of the fourteen died.

The febrile movement, which gradually becomes more pronounced, remits, but does not cease in the morning, and has evening exacerbations. After the first week of fever the remissions are less marked, but the fever is not uniform at any period in its course. Hence some of our ablest writers on diseases of children continue to designate typhoid fever of children remittent fever, fully aware of its identity with typhoid fever of the adult. As the case advances, the appetite fails, all solid food being refused, and liquid food being taken more from thirst than hunger. The tongue in the first week, and in some patients throughout the course of the disease, is covered with a light moist fur, while in others having a graver type of the fever the tongue after the first week is dry and brown. During the prodromic period, and in the first week, the bowels act regularly, or are slightly relaxed, and they are readily affected by purgative medicines. After the first week there is in most children a tendency to diarrhœa, which requires now and then the use of astringents, the stools being watery and brown, or dark yellow. The abdominal walls are seldom retracted, but prominent, especially after the first week, in consequence of meteorism, which is present in children as well as adults. Sometimes there is apparent tenderness, when pressure is made over the right iliac region, but this must not be confounded with hyperæsthesia, which is common in the commencement of febrile diseases in children, and which is observed especially upon the abdomen, chest, and inner part of the thighs.

The respiration in the first week is slightly accelerated, as it is in all febrile diseases. In the second week, and subsequently when bronchitis is developed, the respiration is ordinarily more accelerated, though not in a marked degree, unless in those exceptional instances in which there is an abundant collection of mucus in the smaller bronchial tubes. A cough is often present, dependent on the bronchitis, and varying in character according to the degree and stage of the inflammation. In the first days of the fever it is infrequent, or lacking; at a later stage it is more frequent, and not so dry, though in cases of ordinary severity the amount of expectoration is inconsiderable. Hypostatic congestion, œdema, hypostatic pneumonia, splenization, or thickening of the alveolar walls, and collapse, which may, and some of which not infrequently do occur in the advanced disease, increase, more or less, the frequency of the respiration and the cough, and modify the physical signs.

The pulse in the first week, in ordinary cases, is from 100 to 110 or 115. It gradually becomes more accelerated, numbering in the second week 123 or more; in grave cases even 160. The more frequent the pulse, the greater the danger and more unfavorable the prognosis. During the exacerbations the number of pulsations per minute is 15 or 20 more than in the remissions. The change in temperature corresponds with that of the pulse, being from 1° to 2° higher in the ex-

acerbation than remission. The extremes of temperature in cases of ordinary severity are about 101° to 104°. A temperature above 105° shows a grave, probably a fatal type of the disease, or else a serious complication.

There is great variation as regards the symptoms referable to the nervous system. Headache is common in the prodromic and initial stages, after which it ceases. A few are delirious even from an early period, screaming loudly, or muttering incoherently, but the majority are quiet, having, indeed, a degree of mental dulness, but being able to appreciate questions when aroused, and answering correctly. Subsultus tendinum and carphologia, which some exhibit, show that there is profound disturbance of the nervous system. Epistaxis occurs occasionally in the first week, as in the adult, but is not abundant.

The rose-colored eruption appears in children as well as adults between the sixth and twelfth days, but is more frequently absent in the former than the later; sometimes the number of spots is less than half a dozen. Sudamina are common in the second and third weeks, and perspirations may occur at any time in the course of the fever, but without amelioration of symptoms. More or less deafness is common, being in most instances a purely nervous symptom, without, therefore, any structural change in the ear, but it is possible, as has been suggested by certain writers, that it sometimes results from inflammatory thickening of the Eustachian tube or external meatus, or from a weakened and flabby state of the muscles of the ear.

The duration of typhoid fever is not uniform; while mild cases may end in two weeks, those of a severer type continue three or even four. The patient becomes progressively more emaciated and feeble. In protracted and severe cases his condition seems very unpromising to one not familiar with the clinical history of the fever. Pale, emaciated, and feeble, probably passing his evacuations in bed, taking little notice of objects around him, he presents, at the close of the third week, an appearance of helplessness, notwithstanding the best of nursing, and the constant employment of sustaining measures, which is truly discouraging.

Complications.—The chief complications of typhoid fever are broncho-pneumonia, already sufficiently described, enteritis, intestinal hemorrhage, peritonitis, otitis, parotiditis, and muguet. In one instance I lost a patient about ten years old, in whom the fever had nearly terminated, by the sudden accession of croup. There is, as we have seen, in ordinary cases, more or less inflammation of the mucous membrane of the air-passages, and of the intestines, especially, in the vicinity of the patches of Peyer. It is easy to understand how, under circumstances which may arise in the fever favorable to the development of mucous inflammations, the bronchitis and enteritis may so increase as to constitute complications. They are the most frequent of the serious complications.

Feeble action of the heart, common in severe cases of typhoid fever, and which after the second week is partly attributable to granulo-fatty degeneration of the muscular fibres of the heart, which is frequent in grave forms of the infectious diseases, obviously favors the occurrence

of bronchial and pulmonary congestion. Hence the proneness in these cases of the inflammation to extend downward from the larger to the smaller bronchial tubes and to the lungs, so that broncho-pneumonia becomes an occasional very grave complication.

In the child as well as adult with this disease, the mucous membrane of the lower part of the ileum in the vicinity of Peyer's patches is frequently thickened and hyperæmic, a true intestinal catarrh. We can readily understand how under certain circumstances this may become aggravated, so as to constitute an intestinal inflammation of considerable extent and gravity, a severe entero-colitis, so that the local symptoms predominate over the constitutional and aggravate the later.

In the adult, as is well known, the Peyerian and solitary glands becoming more and more prominent by proliferation of the cellular elements (the lymphoid cells), begin to ulcerate in the second week, and slough in the third, forming the typhoid ulcer, which is slow in healing, and aids in keeping up the diarrhœal state. Such destructive or necrotic inflammation is rare in young children, but it may occur in those of a more advanced age.

Intestinal hemorrhage is therefore an occasional accident. Hillier met four cases in thirty of the fever. It indicates the presence of ulcers upon the surface of the intestines. The younger the child, the less the liability to it. Some, in whom it has occurred, recover, but others die.

Intestinal perforation is more rare in children than in adults, as might be inferred from the statement already made, that intestinal ulceration is less frequent and extensive in them. Statistics show that perforation occurs only once in 232 cases. Therefore, as perforation is the common cause of peritonitis in this disease, this inflammation is a rare complication. Peritonitis may, however, occur in typhoid fever without perforation. In one such case (an adult) in the fever wards attached to Charity Hospital, local peritonitis with fibrinous exudation occurred opposite two ulcerated patches of Peyer, the ulcers extending nearly to the peritoneum, but not perforating. The lesions observed in this case throw light on those cases of peritonitis complicating typhoid fever which recover, the cause of which has received a different explanation.

In advanced and greatly debilitated cases, thrush sometimes appears in the interior of the mouth, and upon the fauces. It is always an unfavorable prognostic symptom in children suffering from chronic or protracted disease. Parotiditis is also a rare complication. Otitis, commencing with pain, and producing a discharge which may continue for weeks, is not rare, though less frequent than in scarlet fever. The otitis is commonly external, but it may, in scrofulous subjects, extend to the middle ear.

Diagnosis.—This is more difficult in children than in adults, and the younger the child the greater the difficulty. In infants protracted entero-colitis, with febrile action and dry furred tongue, cannot in certain cases be positively diagnosticated from typhoid fever by the symptoms and clinical history. Typhoid fever is believed, however, to be rare at this age, for an infant nourished at the breast, and rarely drinking from a cup, is very seldom exposed to the cause of the disease. When, however, as now and then happens, a young child presents the

symptoms characteristic of protracted subacute entero-colitis, or typhoid fever, and older members of the household have the fever, it is highly probable that the case is one of the latter disease, and it should be treated accordingly.

Even in older children typhoid fever is frequently mistaken for simple subacute enteritis, or entero-colitis, or *vice versâ*. The following facts aid in the differential diagnosis. In typhoid fever there is total loss of appetite, while in the subacute intestinal inflammation food is not entirely refused. Diarrhœa commences early in the inflammation, while in the fever it is not ordinarily till after the lapse of a few days. Abdominal tenderness in the fever is not appreciable, or is located in the right iliac region; in the other disease it is general over the abdomen, or located in the umbilical region. In typhoid fever there is bronchitis with a cough which is absent in the inflammation. In typhoid fever there are certain other symptoms, more or fewer of which are present in most cases, and which do not occur in the intestinal diseases, except as a coincidence; for example, headache, epistaxis, stupor, delirium, and perhaps the rose-colored spots.

Typhoid fever may be mistaken for meningitis, during the first week, but in meningitis there is more constipation, irritability of stomach, and less elevation of temperature. Moreover, in meningitis, at a comparatively early stage, we are able to detect patches of congestion of the features coming and disappearing suddenly; and slight inequality of the pupils, or their oscillation when the light is uniform; signs which are lacking in typhoid fever. In a doubtful case the ophthalmoscope might be employed, which in meningitis discloses congestion of the vessels of the retina, œdema, etc., anatomical changes which do not pertain to typhoid fever.

The differential diagnosis of typhoid fever and acute tuberculosis may be made by attention to the following points. In tuberculosis there is cough, with some acceleration of respiration from the first, without epistaxis, stupor, or other nervous symptoms, and without the abdominal symptoms which are so prominent in the fever.

Duration.—The duration of typhoid fever varies from one to about five weeks, but complications which may arise may protract the febrile movement. Henoch states that in eighty cases which came under his observation, the duration in 7 was from 7 to 9 days, in 30 from 10 to 15 days, in 31 from 15 to 23 days, in 7 from 23 to 35 days, and in 5 from 35 to 49 days. Recovery from a severe and protracted attack is slow, several weeks or even months elapsing before complete restoration to health. A tendency to diarrhœa often continues several weeks after the fever proper ceases, necessitating a rigid oversight of the diet, and the occasional employment of astringents. The milder the attack of typhoid fever, the less, as a rule, are the intestinal lesions, and since ulcerations of Peyer's patches are absent or slight in children, there is little danger from this source in them. In the adult, on the other hand, the intestinal disease constitutes one of the chief sources of danger, and it renders convalescence uncertain and protracted. Henoch states that of 137 cases of typhoid fever in children he lost only 16.

Prognosis.—A much larger percentage of children recover than of adults. Although there be great emaciation with loss of strength recovery may be confidently predicted, provided that no serious complication occur. In fatal cases which I have met, the unfavorable result occurred, as a rule, from the complications, rather than directly from the malady. The condition in which severe typhoid fever leaves a patient is favorable for the development of tubercles, and now and then they occur, disappointing our expectations and prediction of recovery.

Treatment.—Typhoid fever, like typhus, cannot be abridged by treatment, and the indication is to sustain the vital powers, diminish the intensity of the febrile movement, and to control any untoward symptom or complication. Quinia, so useful in malarial diseases, may be administered in small doses for its tonic effect, and as an aid in promoting digestion. It is commonly and properly prescribed in some convenient vehicle for this purpose, but it does not antagonize the typhoid, as it does the malarial poison. Perturbating medicines, and especially cathartics, should be given with caution. The tendency to intestinal ulceration and hemorrhage, and the anæmic nature of the fever, require abstinence from or cautious use of such agents. A temperature remaining under 103° usually involves little danger. If it rise above that, antipyretic measures should be employed. The use of salicylate of sodium, large doses of quinine, and cold-water ablutions, are the three admissible remedies for this state. The salicylate I suspect impairs the appetite, and retards digestion, and the quinine is much less efficient as an antipyretic in this fever than cold-water bathing. I therefore order the nurse to bathe frequently the forehead, face, hands, arms, neck, and sometimes the chest, with cold water, to which it is proper to add alcohol or some spirituous lotion. A cloth wrung out of ice water or an ice bag should be applied over the head, and the hands may be allowed to lie a considerable time in a wash-bowl containing the lotion, which is always grateful to the patient. The water treatment thus applied will usually reduce the temperature one, two, or three degrees within a few hours.

In all cases of typhoid, as in other essential fevers, free ventilation is required from an open window, and the bedding and body linen should be changed every day.

Observations made during the last dozen years appear to show that the mineral acids have a salutary effect upon the course of the fever.

The dilute nitric, muriatic, or nitro-muriatic acid should be given largely diluted with water, and, if possible, through a glass tube so as to protect the teeth. I have recently administered the dilute muriatic acid in the acidulated liquid pepsin prepared by Mr. Kress, of Fifty-second Street and Broadway, in the treatment of typhoid fever. One ounce of the liquid contains 30 min. of the dilute acid, and one teaspoonful can be given every third hour to a patient of five years. The scanty secretion of gastric juices in this disease, the poor appetite and slow digestion, indicate the need of such medicine, and thus far the result has been good.

If the pulse be rapid and weak, or fluctuating, digitalis meets the special indication, and it can be administered with or between the doses

of quinine. As there is great proneness to diarrhœa and intestinal ulceration, the selection of the proper diet is important, and of all the dietetic articles milk is the one upon which we must chiefly rely for the sustenance of the patient. While it contains the desired nutriment it is easy of digestion, and possesses, when fresh and of good quality, no irritating property which would aggravate the intestinal disease. The meat broths or juices, fresh eggs beaten up in milk, farinaceous foods, as barley, wheat, or rice flour in the milk, are proper adjuvants to the milk diet. The dry state of the mouth, and scanty secretion of saliva, and probably also of the pancreatic juice by which starch is digested, show, however, that only a moderate amount of farinaceous food can be assimilated during the fever. The patient may be allowed to drink cold water in moderate quantity.

Mild cases of typhoid fever do not require alcoholic stimulants, but they are useful in severe cases in the form of wine whey or milk punch, especially in the third and fourth weeks, and during convalescence. When the pulse is feeble and quick, the mind wandering, and the fingers tremulous, the regular and judicious use of alcohol aids materially in sustaining the vital powers during the critical period.

The complications which may arise in the course of the fever require prompt treatment. For diarrhœa opium and bismuth are needed; for intestinal hemorrhage an ice bag over the right iliac region, and internally opium with acetate of lead, or with a large dose of subnitrate of bismuth, or small and repeated doses of turpentine. A one-grain ergotine pill every fourth hour to a child of eight years, also aids in arresting the hemorrhage. But intestinal hemorrhage as a result of typhoid ulcerations is much more rare in children than in adults. Bronchitis and pneumonia require mildly irritating poultices, with the oil-silk jacket.

Typhoid fever may relapse, but the second attack is commonly milder than the first. Nevertheless on account of the liability to its return, the patient should be quiet and free from perturbating influences during convalescence.

To guard against the spread of the disease, the stools should always be promptly disinfected, by adding to the night-stool carbolic acid and a solution of the sulphate of iron, or a solution of the chlorides, and all soiled linen should be placed in boiling water.

CHAPTER IV.

CEREBRO-SPINAL FEVER.

Several years ago, before New York physicians had any personal experience with cerebro-spinal fever, an outbreak of it of moderate extent occurred at or near Long Branch, and from its proximity, physicians were apprehensive that it might enter New York. Very interesting discussions consequently took place in the Academy of Medicine concerning the cause and nature of this malady, and theories crude and unfounded, in consequence of inexperience, were then expressed. Unfortunately the fears of physicians who participated in that discussion have been realized. The disease entered this city in the autumn of 1871, appearing first among the horses of the large stables of the stage and car lines, disabling and destroying many of them. In December, 1871, it commenced among the people, and since that time it has not been absent from the city. Its unknown cause, which in country towns soon dies out or becomes inoperative, from lack of the conditions which sustain and perpetuate it, finds in this great assemblage of people, and in the state of the streets and domiciles, the conditions favorable for its development and sustenance, so that cerebro-spinal fever is now fully established with us. It has become one of the scourges of childhood, destroying many lives each year, and injuring irreparably, by deafness or in other ways, many who recover. We are now much better prepared, by sad experience, to discuss this disease than were those physicians who participated in the debates alluded to above.

Etiology.—It is not improbable, from the clinical history of cerebro-spinal fever, and from recent discoveries touching the parasitic origin of several of the common constitutional maladies, that the obscure and mysterious cause of cerebro-spinal fever will yet be discovered by microscopical and clinical research. Leyden, indeed, has published in a recent issue of the *Cent. f. Klin. Med.*, p. 61, a paper on the micrococcus of cerebro-spinal meningitis, and M. Ernest Gandier[1] states that he has discovered in the blood and urine of a patient, examined fresh and with "antiseptic precautions," micrococci in great abundance. But proof is lacking that these micrococci sustain a causative relation to the disease.

At the debates in the Academy the question was raised whether the cause might not reside in the cereals or some other agricultural products. This is improbable, for of two adjacent localities, in which the diet of the inhabitants is the same, one escapes and the other is visited by the epidemic. The disease ceases after a time, although the food of the people remains unchanged. Infants at the breast having only the

[1] Rev. Médicale, June 3, 1882; New York Medical Record, September 9, 1882.

mother's milk are sometimes affected, and likewise certain animals whose food is very different from that of man, and finally the most careful examinations have hitherto failed to discover any dietetic cause of the malady. That the cause does not emanate from the soil, directly at least, is probable from the fact that many epidemics commence in the winter when the ground is frozen, and that they occur in localities where there is every kind of soil and the most diverse geological formations. Probably, therefore, the cause, whatever its origin and nature, resides in the atmosphere, and enters the system through those channels which receive air. Prof. Wm. H. Welch writes to me on this subject: "Worthy of consideration, though unproven, is the view of Medin, that the infectious material is absorbed by the lymph-spaces of the nasal mucous membrane, which, according to Key and Retzius, communicate on the one side with the atmosphere through openings between the epithelial cells, and on the other side with the subarachnoid spaces at the base of the brain."

Among the conditions which are favorable for the occurrence of cerebro-spinal fever, and may therefore be regarded as predisposing to it,

FIG. 25.

we may mention the winter season. Statistics collected in Europe and the United States show that while 166 epidemics occurred in the six months commencing with December, only 50 were in the remaining six months of the year. According to the statistics of Prof. Hirsch, which were collected mainly from Central Europe, 57 epidemics were in winter or winter and spring, 11 in spring, 5 between spring and autumn, 4 commenced in autumn and extended into winter, or into winter and the ensuing spring, and 6 lasted the entire year. I suspect that the opinion expressed by Prof. Hirsch is correct, that the excess of epidemics in the winter months is due mainly to the greater crowding and less ventilation in the domiciles during the cold than warm months, especially among European peasantry. In New York City, where the state of the domiciles is about the same the year round, the season appears to exert little influence on the prevalence of the disease.

All observers have remarked the fact that anti-hygienic conditions increase the liability to cerebro-spinal fever; in other words, produce

such a state of system that it more readily yields to the morbific influence and contracts the malady. Hence soldiers in barracks and the poor in tenement houses suffer most severely when the epidemic is prevailing. In New York City the fact is often remarked that multiple cases occur for the most part where obvious unsanitary conditions exist, as in apartments which are unusually crowded and filthy, or in tenement-houses around which refuse matter has collected, or which have defective drainage. The interesting chart prepared under the direction of Dr. Moreau Morris for the Health Board, shows that comparatively few cases occurred in the epidemic of 1872 in those portions of the city where the sanitary conditions were good. Anti-hygienic conditions probably predispose to cerebro-spinal fever in the same way that they do to other grave epidemic disease, as, for example, to Asiatic cholera, whose ravages are chiefly where hygienic requirements are most neglected. We will presently relate striking examples which show how foul air increases the number and malignancy of cases.

Is Cerebro-spinal Fever Contagious?—It is the almost unanimous opinion of those who are most competent to judge from their observations, that it is either not contagious or is contagious in only a slight degree. It is certain that the vast majority of cases occur without the possibility of personal communication. Thus, in the commencement of an epidemic, the first patients are affected here and there, at a distance from each other, often miles apart, and throughout an epidemic, usually only one is seized in a family. Children may be around the bedside of the patient, passing in and out of the room without restriction, and yet we can confidently predict that none of them will contract the malady, if there be proper ventilation and cleanliness, and none of the conditions of insalubrity exist within or around the domicile. Moreover, when multiple cases occur in a family, the disease begins at such irregular intervals in the different patients, that there can be little doubt in most instances that it is not communicated from one to the other, but, like the fevers from marsh miasm, is produced by exposure to the same morbific cause, existing outside the individuals, but within or around the premises. Thus in the Brown family treated by the late Dr. John G. Sewall,[1] of New York. The first child sickened January 30th, and subsequently the remaining five children at intervals respectively of five, seven, eleven, twenty-five, and forty-five days. That so many were affected in one family was attributed by the doctor to the filthy state of the house and the bad plumbing, which allowed the free escape of sewer-gas. In my own practice, in the family which suffered the most severely of all, four patients were seized in succession, and yet I could see no evidence of contagiousness. The family occupied a small plot of ground, not more than thirty feet by one hundred, and their occupation was to prepare for the meat-market what is known as head-cheese. They lived on the second floor of the two-story wooden house in which the work was carried on. At the time of the sickness the shop contained four hundred heads of animals from which the meat for the cheese was obtained, and evidently more or less decaying animal matter was present. The occupation and surroundings of this

[1] Medical Record, July, 1872.

family afforded sufficient explanation of the fact that so many were attacked. Two workmen contracted the disease within about one week of each other, and were removed from the house. Four weeks after the commencement of the malady in the workman who was first attacked, on January 26th, one child sickened with it, and died on February 1st. Fifteen days subsequently (February 16th) a second child was attacked by it, and after a tedious sickness finally recovered. The long and irregular intervals between these cases indicate that the disease was not contracted by one from the other. The important factor in causing so severe an outbreak of cerebro-spinal fever in this family was probably the miasm produced by such an occupation in the house where the family resided, with neglect of ventilation and cleanliness.

But the strongest evidence that cerebro spinal fever is either non-contagious, or very feebly contagious, is afforded by the fact that a large majority of the cases occur singly in families, although there is no isolation of the patients. The following are the statistics relating to this point of the cases which I have observed since cerebro-spinal fever commenced in New York, in 1871: Single cases occurred in seventy families; dual cases occurred in nine families; three cases occurred in one family, and four cases in one family. Intercourse with the sick-room was unrestricted in all these families, so that children frequently went out and in, and sometimes assisted in the nursing.

The most striking example of apparent contagiousness which has come to my knowledge was related by Hirsch, and is quoted by von Ziemssen. A young man sickened with cerebro-spinal fever on February 8th. The woman who nursed him returned to her home in a neighboring village and there died of the same disease on February 26th. To her funeral mourners came from a neighboring township, and after their return home three of them died with the same disease, one within twenty-four hours, another on March 4th, and a third on the 7th.

In one instance only in my practice did the facts point to contagiousness. A boy of twelve years died of cerebro-spinal fever and was buried on Saturday or Sunday. On Monday the mother washed the linen and bedclothes of the boy, which had accumulated and were in a very filthy state. Two days subsequently she was attacked, and her infant soon afterward, both perishing. The state of the bedding and apartments in this house, as seen by myself, was such as would be likely to concentrate and intensify the poison, rendering it peculiarly active, for they were very dirty, and the mother, exhausted by her long and incessant watching and lack of sleep, and depressed by grief, rendered her system more liable to the disease by her self-imposed duties on the day after the funeral. One in her state of mind and body, standing for a considerable part of a day over the bedclothes and bedding of her child, soiled by the excreta, would certainly be in a condition to contract the disease if it were in any, even in the lowest degree, contagious. In the present state of our knowledge, therefore, upon this important subject, the evidence leads us to believe that with proper ventilation and cleanliness, and the suppression of anti-hygienic conditions in an infected domicile, those who are in a good state of body and mind will not contract the

disease, but in the opposite conditions it is not improbable that the poison may be so intensified, and the system rendered so liable to receive the prevailing malady, through impairment of the general health and diminished resisting power, that cerebro-spinal fever may, though rarely, be communicated either by the breath of the patient, or by exhalations from his surface, or from soiled clothing. If so, it of course possesses a low degree of contagiousness.

The occurrence of cerebro-spinal fever in certain of the lower animals is a very interesting fact, especially as the question is sometimes asked whether it may not be communicated from them to man. In the epidemic of 1811 in Vermont, according to Dr. Gallop, even the foxes seemed to be affected, so that they were killed in numbers near the dwellings of the inhabitants. Cerebro-spinal fever, previously unknown in New York City, began, as stated above, in 1871, among the horses in the large stables of the city car and stage lines, disabling many and proving very fatal, while among the people the epidemic did not properly commence till January, 1872, although a few isolated cases occurred in December of 1871. No evidence exists, so far as I am aware, that the disease was, in any instance, communicated by these animals to man. Those who had charge of the infected horses, as the veterinary surgeons and stablemen, did not contract the malady, certainly not more frequently than others who were not so exposed. Although we may admit slight contagiousness, there has probably been no well-established example of the transmission of cerebro-spinal fever from animals to man. If transmission ever does occur, it is so rare that practically no account need be made of it.

In some instances we are able to discover an exciting cause. An individual whose system is affected by the epidemic influence, may perhaps escape by a quiet and regular mode of life, but if there be any unusual excitement, or the normal functional activity of the system be seriously disturbed, an outbreak of the malady may occur. Among the exciting causes we may mention over-work and lack of sleep, fatigue, mental excitement, depressing emotions, prolonged abstinence from food followed by over-eating, and the use of indigestible and improper food. Thus in one instance among my cases, a delicate young woman, at the head of one of the departments in a well-known Broadway store, was anxious and excited, and her energies overtaxed, at the annual reopening. Within a day or two subsequently the disease began. Another patient, a boy, was seized after a day of unusual excitement and exposure, having in the meantime bathed in the Hudson when the weather was quite cool. Those children have seemed to me especially liable to be attacked who were subjected to the severe discipline of the public schools, returning home fatigued and hungry and eating heartily at a late hour. In one instance which I observed, a school-girl, ten years of age, returned from school excited and crying because she had failed in her examination and had not been promoted. In the evening, after she had closely studied her lessons, the fever began with violent headache.

Dr. Frothingham[1] writes as follows of the brigade in which cerebro-

[1] American Medical Times, April 30, 1864.

spinal fever occurred in the Army of the Potomac: "Under General Butterfield, a stern disciplinarian, . . . the men were drilled to the full extent of their powers, often to exhaustion. I did not at the time recognize this as the cause of the disease in question, but I learnt that in the present epidemic in Pennsylvania the attack generally follows unusual exertion and exposure to cold."

Many observers have noticed that bodily fatigue and mental depression and excitement are important factors in causing an attack of cerebro-spinal fever, when this disease is epidemic. Dr. Gallop, in his history of cerebro-spinal fever, as it occurred in Vermont in 1811, directs attention to the severity of the cases among the troops under General Dearborn, who were fatigued by marches and greatly dispirited on account of a repulse which they had just sustained from the British. In one case, which occurred in my practice, a boy, six years and eleven months of age, was punished at school and came home with cheeks flushed from excitement, the excitement continuing during the ensuing night. On the following day cerebro-spinal fever began with vomiting and chilliness, the attack ending fatally on the seventeenth day. In another case, which was related to me by the mother and the physician, the patient, a bright girl, twelve years of age, of nervous temperament, and forward in her studies, had been much excited in competing for a prize in athletic exercises. In the evening of the same day a violent thunder-storm occurred, and after a severe clap she started from bed, pallid and excited, and expressed the belief that she had been struck by lightning. The disease began immediately after this, and terminated fatally on the fifth day.

Sex.—It is stated by certain writers that more males are affected than females. The statistics of hospitals and camps show this; for men subject to lives of hardship are especially liable to be attacked, but in family practice, in which a large proportion of the patients are children, the number of males and females is about equal. Thus in 105 cases, occurring chiefly in my practice, but a few of them in the practice of two other physicians of this city, I find that 59 were males and 46 females. Ninety-one of these were children. In New York City, during the epidemic of 1872, 905 cases of cerebro-spinal fever were reported to the Health Board between January 1st and November 1st, and of these 484 were males and 421 females. Dr. Sanderson's statistics of the epidemic in the provinces around the Vistula, the cases being chiefly children, give also but a slight excess of males. Probably, therefore, in the same conditions and occupations of life the sexes are equally liable to contract this malady, and the excess of males is due to the fact that they lead a more irregular life, and are more subject to privations and exposures. That soldiers on duty or in barracks have been attacked while families in the vicinity escape, thus increasing the proportion of male cases, must be due to irregularities, hardships, and perhaps the lack of sanitary regulations in the mode of their life.

Age.—Children, as already stated, are much more apt to contract cerebro-spinal fever than adults. The following are the statistics of the N. Y. Health Board relating to the age of the cases during the epidemic of 1872:

Under 1 year	125
From 1 to 5 years	336
From 5 to 10 "	204
From 10 to 15 "	106
From 15 to 20 "	54
From 20 to 30 "	79
Over 30 years	71
Total	975

In the cases which occurred in my own practice, and in a few cases in the practice of other physicians added to mine, I find that the ages were as follows:

Under 1 year	16
From 1 to 3 years	27
From 3 to 5 "	25
From 5 to 10 "	20
From 10 to 15 "	10
Over 15 years	15
Total	113

In my practice, therefore, three-fourths of the cases have been under the age of ten years, and the statistics of epidemics in other localities correspond with mine in giving a large excess of cases in childhood. Thus Dr. Sanderson, in examining the records of deaths in one epidemic ascertained that two hundred and eighteen had perished under the age of fourteen years, and only seventeen above that age; and although this does not show the exact ratio of children to adults in the entire number of cases, it is evident that the children were greatly in excess.

The more advanced the age after the tenth year, the less the liability to this malady, so that very few who have passed the thirty-fifth year are attacked, and old age possesses nearly an immunity. In New York City, in which, as we have seen, cerebro-spinal fever has been occurring since 1871, only two cases have come to my knowledge which had passed the fortieth year. The age of one was forty-seven, and the other sixty-three years.

Symptoms.—During the prevalence of cerebro-spinal fever cases now and then occur in which the symptoms are mild and transient, and the health is soon fully restored. It seems proper to regard some, at least, of these as genuine but aborted forms of the disease. The following cases which occurred in my practice may be cited as examples:

A boy, eight years of age, previously well, was taken with headache, vomiting, and moderate febrile movement, on April 2, 1872. The evacuations were regular and no local cause of the attack could be discovered. On the following day the symptoms continued, except the vomiting, but he seemed somewhat better. On April 4th the febrile movement was more pronounced, and in the afternoon he was drowsy and had a slight convulsion. The forward movement of the head was apparently somewhat restrained. On the 6th the symptoms had begun to abate, and in about one week from the commencement of the attack his health was fully restored.

A boy, aged six, was well till the second week in May, 1872, when he

became feverish and complained of headache. At my first visit, on May 14th, he still had headache, with a pulse of 112. The pupils were sensitive to light, but the right pupil was larger than the left. The bromide and iodide of potassium were prescribed, with moderate counter-irritation behind the ears. The headache and febrile movement in a few days abated, the equality of the pupils was restored, and within a little more than one week from the commencement of the disease he fully recovered.

These cases occurred when the epidemic of 1872 was at its height; but if the symptoms are so mild, and the duration of the disease short, as in these two cases, the diagnosis must sometimes be doubtful. Observers in different epidemics report similar cases, and as the symptoms, so far as they appeared in my patients, seemed characteristic, I have not hesitated to regard them as genuine but aborted cases. On such patients the epidemic influence acts so feebly, or their ability to resist it is so great, that they escape with a short and trivial ailment.

Occasionally, also, during the progress of an epidemic, we meet patients who present more or fewer of the characteristic symptoms, but in so mild a form that they are never seriously sick, and never entirely lose their appetite, but the disease, instead of aborting, continues about the usual time.

Thus, on January 4, 1873, I was called to a girl aged thirteen, who had been seized with headache followed by vomiting in the last week in December. During a period of six to eight weeks, or till nearly March 1st, she had the following symptoms: Daily paroxysmal headache, often most severe in the forenoon; neuralgic pain in the left hypochondrium, and sometimes in the epigastric region; pulse and temperature sometimes nearly normal, and at other times accelerated and elevated, both with daily variations; inequality of the pupils, the right being larger than the left during a portion of the sickness. The patient was never so ill as to keep the bed, usually sitting quietly during the day in a chair or reclining on a lounge, and she never fully lost her appetite. Quinine had no appreciable effect on the fever or paroxysms of pain. There can, in my opinion, be little doubt that this girl was affected by the epidemic, but so mildly that there was, for a considerable time, much uncertainty in the diagnosis.

Cases like these, in which the disease is so feebly developed that the patient is never seriously sick, though unimportant pathologically, must be recognized in a treatise on cerebro-spinal fever.

Mode of Commencement.—Cerebro-spinal fever rarely begins in the forenoon after a night of quiet and sound sleep. In the cases which I observed in the severe and fatal epidemic of 1872, and in the thirty-six cases of which I have records observed since 1872, the commencement was almost without exception between mid-day and midnight. The fact that this disease does not commence after the repose of night, till several hours of the day have passed, shows the propriety and need of enjoining a quiet and regular mode of life, free from excitement, and with sufficient hours of sleep, during the time in which the epidemic is prevailing.

The commencement is usually without premonitory stage, and sudden; unlike, therefore, the beginning of other forms of meningitis, which come

on gradually and are preceded by symptoms which, if rightly interpreted, direct attention to the cerebro-spinal system. Exceptionally certain premonitions occur for a few hours or days before the advent of the disease, such as languor, chilliness, etc. Mild cases more frequently begin gradually, and with certain premonitions, than severe cases. The ordinary mode of commencement is as follows: The patient is seized with vomiting, headache, and perhaps a chill or chilliness, so that there is a sudden change from perfect health to a state of serious sickness. Rigor or chilliness is a common initial symptom, especially in adult patients. One patient, an adult female, had three or four chills of considerable severity in the commencement of the attack. Children often have clonic convulsions in place of the chill, or immediately after it, partial or general, slight or severe. Stupor more or less profound, or less frequently delirium succeeds. In the gravest cases semi-coma occurs within the first few hours, in which patients are with difficulty aroused, or profound coma, which, in spite of prompt and appropriate treatment, is speedily fatal. Those thus stricken down by the violent onset of the disease, if aroused to consciousness, complain of severe headache, with or without, or alternating with equally severe neuralgic pains in some part of the trunk, or in one of the extremities. The pain frequently shifts from one part to another. Among the early symptoms of cerebro-spinal fever are those which pertain to the eye. The pupils are dilated, or less frequently contracted, and they respond feebly, or not at all, to light if the attack be severe and dangerous; often they oscillate, and occasionally one is larger than the other. Vomiting with little apparent nausea, and often projectile, is common in the commencement of cerebro-spinal fever. It occurred as an early symptom in fifty-one of fifty-six cases observed by Dr. Sanderson. In ninty-seven cases occurring in New York, most of them observed by myself, but a few of them related to me by the late Dr. John G. Sewall, vomiting occurred as an early symptom in sixty-eight cases. Its absence on the first day was recorded in only three cases, while in the remaining twenty-seven patients the records of the first day make no mention of its presence or absence. It was probably present in most of these twenty-seven cases as one of the first symptoms.

Since the epidemic of 1872, in examining patients now numbering thirty-six, as has been already stated, I have made careful inquiry in regard to the mode of commencement, and with only two or three exceptions the previous health had either been good, or if symptoms of ill-health antedated the cerebro-spinal fever, they were due to some ailment entirely distinct from this disease. In a boy four and a half years of age, living in Broadway, it was stated to me that the cerebro-spinal fever came on gradually, with pains in the head and elsewhere; this case was mild throughout, and the patient was never in imminent danger. In nearly all the cases, if the patients were at home and under observation, the exact moment of the beginning of the disease could be stated. Thus a man aged twenty-eight returned from his work at midday, April 23, 1883, in good health and cheerful, ate a hearty meal at 12 M. and at 1 P. M. had a chill, with intense headache and severe vomiting. Minute red points appeared on his face after the vomiting from capillary extravasa-

tions. In this case the interesting fact was observed of a cessation of the symptoms, so that on the 24th and 25th, being free from pain, he went to Brooklyn. On the 26th, however, the symptoms returned. He had pains in the head, back, and extremities, and was seriously sick. Occasional remissions, so that very grave symptoms become mild for a time, and then return in full severity, as well as distinct intermissions as in this case, have been frequently noticed by observers in different epidemics. A little girl, previously entirely well, was slightly punished on June 11, 1882; immediately she vomited, and seemed quite sick; by kind nursing on the part of the mother she became better, so that on the 12th she had some appetite and went out. On the 13th, cerebro-spinal fever began, with a temperature of 103°, and its course was tedious. A robust girl, aged thirteen, vivacious and cheerful, went as usual in the morning to one of the public schools, entirely well. Before the school was dismissed she returned home crying, on account of dizziness and violent pain on the top of her head, in her knees, and calves of the legs. The case was attended by Professors Alonzo Clark, Knapp, and myself, and was fatal after four and a half weeks. A boy, aged ten, returned from another public school in a similar manner, having gone to it in the morning in apparent perfect health.

We may, therefore, summarize as follows the symptoms which commonly attend the commencement of cerebro-spinal fever: violent pain in some part of the head, and sometimes also in the trunk or limbs, vomiting, a chill or chilliness, clonic convulsions, dizziness, dilated, sluggish, or altered pupils, fever of greater or less intensity according to the severity of the attack, heat of head, and in most patients of the surface generally. If the disease be of a severe and dangerous type these symptoms are frequently followed within a few hours by delirium, semi-coma, or coma.

Symptoms. Nervous System.—Since in cerebro-spinal fever extensive and intense inflammation occurs of the cerebral and spinal meninges, with more or less congestion of the brain and spinal cord, lesions which we will consider hereafter, we would expect that this disease would be attended by severe and dangerous symptoms, inasmuch as the cerebro-spinal axis exerts such a controlling influence upon the functions of the body. Also we would expect that the symptoms would vary according to the portion of the meninges which happens to be most severely inflamed. There is, indeed, variation in symptoms according to the extent and intensity of the meningitis, and the degree in which the cerebro-spinal axis is congested or implicated, but certain symptoms occur in all or nearly all cases, and as they are characteristic they render diagnosis easy.

Pain, already described as an initial symptom, continues during the acute period of the malady. It is ordinarily severe, eliciting moans from the sufferer, but its intensity varies in different patients. Its most frequent seat is the head, and the location of the cephalalgia varies in different patients and in the same patient at different times. One refers it to the top of the head, another to the occiput, and another to the frontal region, and the same patient at different times may complain of all these parts. The pain is described as sharp, lancinating, or boring.

It is also common in the neck, especially in the nucha, the epigastrium, umbilical, and lumbar regions, along the spine (rachialgia), and in the extremities, where it shifts from one part to another. It is more common and persistent in the head and along the spine than elsewhere. The patient, if old enough to speak, and not delirious or too stupid, often exclaims, "Oh! my head," from the intensity of his suffering, but after some moments complains equally of pain in some other part, while perhaps the headache has ceased or is milder. In a few instances the headache is absent, or is slight and transient, while the pain is severe elsewhere. After some days the pain begins to abate, and by the close of the second week is much less pronounced than previously. Vertigo occurs with the headache, so that the patient reels in attempting to stand or walk. I have stated above that vertigo may be a prominent initial symptom, as in the girl of thirteen years, who suddenly became sick in the public school where she was attending, and reached her home with difficulty on account of the headache and dizziness. Contributing to the unsteadiness of the muscular movements is a notable loss of flesh and strength, which occurs early and increases.

The state of the patient's mind is interesting. It is well expressed in ordinary cases by the term apathy or indifference, and between this mental state and coma on the one hand, and acute delirium on the other, there is every grade of mental disturbance. Some patients seem totally unconscious of the words or presence of those around them, when it subsequently appears that they understood what was said or done. Delirium is not infrequent, especially in the older children and adults. Its form is various, most frequently quiet or passive, but occasionally maniacal, so that forcible restraint is required. It sometimes resembles intoxication or hysteria, or it may appear as a simple delusion in regard to certain subjects. Thus one of my patients, a boy of five years, appeared for the most part rational, protruding his tongue when requested, and ordinarily answering questions correctly, but he constantly mistook his mother—who was always at his bedside—for another person. Severe active delirium is commonly preceded by intense headache. In favorable cases the delirium is usually short, but in the unfavorable it is apt to continue with little abatement till coma supervenes.

On account of the pain and the disordered state of the mind, patients seldom remain quiet in bed unless they are comatose, or the disease be mild or so far advanced that muscular movements are difficult from weakness. In severe cases they are ordinarily quiet for a few moments, as if slumbering, and then, aroused by the pain, they roll or toss from one part of the bed to another. One of my patients, a boy of five years, repeatedly made the entire circuit of the bed during the spells of restlessness. In mild cases, or cases attended by less headache or mental disturbance, patients are quiet, usually with their eyes closed, unless when disturbed.

Hyperæsthesia of the surface is another common symptom. Few patients, not comatose, are free from it during the first weeks, and it materially increases the suffering. Friction upon the surface, and even slight pressure with the fingers upon certain parts extort cries. Gently separating the eyelids for the purpose of inspecting the eyes, and moving

the limbs, or changing the position of the head, evidently increase the suffering, and are resisted. I have sometimes heard such expressions of suffering from slowly introducing the thermometer into the rectum that I was led to believe that the anal and perhaps rectal surfaces were hypersensitive. The hyperæsthesia has diagnostic value, for there is no disease with which cerebro-spinal fever is likely to be confounded in which it is so great. It is due to the spinal meningitis, and is appreciable even in a state of semi-coma. The headache and hyperæsthesia fluctuate greatly in the course of the disease, and the former sometimes recurs at times, especially from mental excitement, or from an afflux of blood to the brain from physical exertion, for months after the health is otherwise fully restored.

Some contraction of certain muscles or groups of muscles is present in all typical cases. In a small proportion of patients it is absent or is not a prominent symptom, namely, in those in whom the encephalon is mainly involved, the spinal cord and meninges being but slightly affected or not all. This contraction is most marked in the muscles of the nucha, causing retraction of the head, but it is also common in the posterior muscles of the trunk, causing opisthotonos, and in less degree in those of the abdomen and lower extremities, and hence the flexed position of the thighs and legs, in which patients obtain most relief. The muscular contraction is not an initial symptom. I have ordinarily first observed it about the close of the second day, but sometimes as early as the close of the first day, and in other instances not till the close of the third day. Attempts to overcome the rigidity, as by bringing forward the head, are very painful, and cause the patient to resist. In young children having a mild form of the fever, with little retraction of the head, the rigidity is sometimes not easily detected. I have been able in such cases to satisfy myself and the friends of its presence, by placing the child in an upright position, as on the lap of the mother, and observing the difficulty with which the head is brought forward on presenting to the patient a tumblerful of cold water, which is craved on account of the thirst. The usual position of the patient in bed, in a typical or marked case, is with the head thrown back, the thighs and legs flexed, with or without forward arching of the spine. The muscular contraction and rigidity continue from three to five weeks, more or less, and abate gradually; occasionally they continue much longer. Through the kindness of Dr. Henry Griswold I was allowed to see an infant of seven months in the tenth week of the disease. It was still very fretful, and exhibited decided prominence of the anterior fontanelle, probably from intracranial serous effusion and marked rigidity of the muscles of the nucha, with retraction of the head.

Paralysis is another occasional symptom, but complete paralysis of any muscle or group of muscles is less frequent than one would suppose from the nature of the malady. It may occur early, but is sometimes a late symptom. It may be limited to one or two of the limbs, as the legs, or an arm and a leg, or it may be more general. In a case occurring in Roosevelt Hospital, and published in the New York *Medical Record* for October 10, 1878, the patient, a boy of ten years, was unable to move his legs one hour after the commencement of the disease.

This sudden development of paraplegia in the commencement of cerebro-spinal fever resembled that of infantile paralysis, and was probably due to the same cause, to wit, active inflammatory congestion of the anterior cornua of the spinal column. The sudden and complete loss of speech which occurs in certain cases, when consciousness is retained and the vocal organs are in their normal state, seems to be due to the fact that the portion of the brain which controls the function of speech is acutely congested, or is the seat of effusion. Thus in June, 1882, a girl of three years, whom I attended, lost her speech on the second day of cerebro-spinal fever, and she was unable to articulate even the simplest word for two and a half months. Finally she began to utter slowly and with difficulty the easiest monosyllables, and now, after a lapse of more than a year, her speech is slow and lisping, while her hands are tremulous and unsteady. She is easily fatigued and cries often from over-sensitiveness. During the long period of speechlessness she daily made efforts to talk, but without uttering a sound. Strabismus, to which we will allude hereafter in treating of the eye, is a common symptom, either transient or protracted, due to paralysis of certain of the motor muscles of the eye.

Paralysis of more or fewer muscles has been noticed and recorded by many observers in this country and in Europe. Dr. Law observed a patient in the epidemic of 1865, in Dublin, who could move neither arms nor legs, and Wunderlich saw one who had paralysis of both lower extremities and a considerable part of the trunk. As this symptom is due to the inflammatory process in the cerebro-spinal axis, it usually disappears in a few weeks as the inflammation abates and absorption of the inflammatory products occurs, but it may be more protracted. In Wunderlich's case there was only partial recovery from the paralysis after the lapse of five months.

Clonic convulsions have already been alluded to among the early symptoms of the attack. They indicate a grave form of the disease, and are not infrequent in young children, in whom they appear to occur in place of the chill which is common in those of a more advanced age. The eclamptic attack may be short and not repeated, or it may be protracted, or return again and again when the medicines which control it are suspended. Under such circumstances it is apt to end in profound coma, and is, of course, a symptom of great gravity. Thus an infant of seven months had unilateral eclamptic attacks daily during the first week of the attack. The mother informed me that the convulsions seldom lasted longer than three minutes, and that the intervals between them were short. The child recovered with loss of sight from the cerebro-spinal fever, but still after the lapse of a year, when I examined him, had symptoms which were apparently due to hydrocephalus. Another infant of eleven months had clonic convulsions nearly constantly during the first twenty-four hours, but with occasional brief intermissions. On the following day he was in profound coma, and apparently dying, with a temperature of 105°. To my astonishment he gradually emerged from the state of unconsciousness, and after a week was able to sit in his cradle long enough to take drinks.

Occasionally eclampsia does not occur in the first days, but in the

second or third week, when it is usually accompanied by an increase of other symptoms, due to a recrudescence of the disease. A female infant, aged eleven months, treated by me in 1882, had been sick one week, when, during an increase in the febrile movement, she had one eclamptic seizure. Her recovery though slow was complete. A boy, aged eleven and one-half years, whose attack began with a chill, violent headache, and a febrile movement, and whom I visited frequently, died on the fourth day. Clonic convulsions did not occur in his case until within twenty-four hours of his death, when he had six seizures, which ended in coma.

Though adult patients are much less liable to eclampsia than children, they are not entirely exempt. A male patient, aged twenty-eight years, whom I saw in consultation, had a single clonic convulsion lasting ten to fifteen minutes on the third day of his illness. In five weeks he had fully recovered, except that his headache returned upon any excitement. Even drinking a cup of beer caused it. Clonic convulsions are, however, much less common than tonic muscular contraction and rigidity already alluded to. This occurs to a greater or less extent in nearly all cases, and is a symptom of diagnostic value, the rigidity often extending to the muscles of the extremities. Thus in a child, aged three years, who had no eclampsia, the tonic contraction of the muscles of the extremities did not relax till after the twelfth day.

Choreic or choreiform movements are occasionally observed. I do not allude to the tremulousness which sometimes occurs from weakness, or as a premonition of eclampsia, but a movement which has the character of true chorea. An infant, aged ten months, began to have choreic movements during the acute stage of the disease, most marked in the upper extremities, and ceasing in sleep. They continued during the remainder of the life of the child, death occurring ten months subsequently from diphtheria. Rarely a choreiform movement of the eyes is also observed, a lateral movement from right to left, and left to right. I have seen from recollection two such cases.

Drowsiness, already alluded to, is a common symptom, and it exists in all grades, from slight stupor to profound coma. In some patients it is present from the first hour, while in others it occurs after a period of restlessness or delirium, or it alternates with it. Stupor more or less profound is common after the attack of eclampsia or the chill. That it is a frequent symptom in severe cases receives ready explanation from the state of the brain and its meninges, for the exudation which occurs upon the surface of the brain and the serous effusion within the ventricles are sufficient to cause it, by compressing the cerebral substance. It is surprising in some cases how profound the stupor may be, a state indeed of coma, and yet the patient gradually emerges from it and recovers. In the epidemic of 1872, in New York City, when the malady was new with us, many physicians predicted certain death, and employed remedies without expectation of any benefit, on account of the apparently hopeless state of patients, who seemed to be in profound coma, and yet not a few of them gradually and fully recovered.

Digestive System.—Vomiting, which is the most prominent symptom referable to the digestive system, has already been alluded to.

Occurring early in the disease, it may cease in a few hours, or not till after several days, and often it returns during the periods of recrudescence which are common in the progress of the fever. It occurs with little effort, and without previous nausea, or with little nausea, as is usual when it has a cerebral origin. It does not differ as a symptom from the vomiting which is so common in other forms of meningitis. The substance vomited consists of the ingesta and the secretions, as mucus and bile. Having a similar origin is a sensation of faintness or depression referred to the epigastrium.

The appetite is usually impaired or lost during the active period of the attack, and it is not fully restored till convalescence is well advanced. Occasionally considerable nutriment is taken, and with apparent relish, as by one of my patients, twenty-eight years of age, who always had some appetite. Ordinarily, on account of repeated vomitings, constant febrile movement, impaired appetite and digestion, patients progressively lose flesh and strength, so that in protracted cases emaciation is always a prominent symptom, and is often extreme. Great emaciation and loss of strength, which attend many cases after the lapse of several weeks, greatly diminish the chances of a favorable termination. Thirst, already alluded to, and constipation are common in this as in other forms of meningitis, but retraction of the abdomen is not a notable symptom, except in protracted and greatly wasted cases. The diarrhœa which is occasionally present in cerebro-spinal fever in the summer months must be regarded as a distinct disease and a complication. The tongue, buccal and faucial surfaces present nothing unusual in their appearance. It is seldom that the sordes and dry and brownish fur occur, which are so common in typhus and typhoid fevers, even in the most protracted and emaciated cases. The tongue is usually moist and but slightly furred.

I have seen in consultation two patients that perished early with inability to swallow as the prominent symptom, attended in both by an abundant secretion upon the faucial surface, without any redness, swelling, or other evidence of inflammation. The early death of these young children, whose ages were ten months and two years, rendered the diagnosis less certain than in most other patients, but the attending physicians as well as myself diagnosticated cerebro-spinal fever with suddenly developed paralysis of the muscles of deglutition, so that no nutriment could be taken. If our understanding of these interesting cases is correct, the paralysis was caused by lesion of that portion of the medulla oblongata which controls the function of deglutition, or else from injury of the intracranial portions of the nerves which supply the muscles concerned in this act. The following were the cases alluded to:

O——, male, two years of age, became feverish and dull, but without vomiting, on October 22, 1882; axillary temperature, 102°. On the following day inability to swallow occurred, and the muscles of deglutition appeared totally inactive. Death occurred on the third day, suddenly, and apparently easily, as if from arrested function of important nerves, especially the pneumogastric. The abundant secretion of thin mucus or transudation of serum covering the faucial surface, and reaccumulating as soon as removed, without any notable change in the appearance of the fauces, was remarkable. The physician in attendance, who for more than

thirty years had had a large city practice, had seen no similar case, nor had I at the time.

Soon afterward the second case occurred. An infant of ten months, without cough or embarrassment of respiration, or faucial redness or swelling, lost the power of deglutition soon after the commencement of the supposed cerebro-spinal fever, so that in the attempts to swallow the drinks entered the larynx, and the secretion or exudation was abundant as in the other case. Death occurred in forty-eight hours. The rectal temperature was only 101°.

In another case, ultimately fatal, and in which the diagnosis of cerebro-spinal fever was certain, a robust girl, aged twelve, suddenly lost the power of deglutition at one time during her sickness, although she was entirely conscious and repeatedly endeavored to swallow. The ability to swallow returned in a few days.

Pulse.—This is usually accelerated, and the more severe and dangerous the attack, the more rapid the heart's action, except occasionally in the comatose state, when probably, in consequence of compression of the brain from an abundant exudation, the pulse may be subnormal. Thus, in one of my patients, an adult, the pulse fell to 40 per minute, and in two others between 60 and 70 per minute. With the exception of these three patients, the pulse in all cases which I have observed, so far as I recollect, has varied from the normal number of beats per minute to such frequency that it was difficult to count it. As death draws near the pulse ordinarily becomes more frequent and feeble. Intermissions in the pulse do not seem to be as common as in other forms of meningitis, but marked variations in its frequency during different hours of the day, and on consecutive days, is a conspicuous symptom. Thus, in a case which was fatal in the fifth week, consecutive enumerations of the pulse, in the acute stage, were as follows, 128, 120, 88, 130, 84, 112.

Temperature.—Some of the older writers, before the days of clinical thermometry, stated that the temperature is not increased. North remarked as follows: "Cases occur, it is true, in which the temperature is increased above the natural standard, but these are rare," and Foot and Gallop make similar statements. Some recent writers have held the same opinion. Thus Lidell wrote as follows in a treatise bearing the date of 1873: ". . . . Febrile symptoms do not necessarily belong to epidemic cerebro-spinal meningitis, as a substantive disease, for it may, and not unfrequently does occur, without exhibiting any such symptoms." We would naturally expect that meningitis, accompanied as it is by active congestion of the brain and spinal cord, would produce more or less fever, and in eighty-six cases which I have examined by the thermometer, I have found elevation of temperature in every case during the acute stage, except in the beginning of the attack in two instances. In a young man, aged twenty-eight years, who had severe headache and seemed seriously sick, the thermometer under the tongue showed no rise of temperature on the first and second days, but on the third day it was at 100°, and it remained elevated till his death, on the thirteenth day. The second case was that of a young woman whom I saw in consultation, and who at the time of my visit had

decided febrile movement, but who, like the young man, had no rise of temperature on the first and second days, according to the careful observations of the attending physician. In the eighty-six cases which I have examined, the heat of the surface occasionally did not seem above normal to the touch, and now and then the thermometer, applied in the axilla or groin, did not indicate fever, but the rectal temperature was always elevated above that of health after the disease was fully established. The temperature fluctuated from day to day, and in different hours of the same day, but there was no exception after the second day to the rule, that it is supra-normal during the active stage of the malady. Sometimes the elevation of temperature was slight, as in a female patient, forty-seven years of age, whom I was allowed to examine with the family physician. The thermometer showed no elevation of temperature when it was placed in the mouth and axilla, but on introducing it into the rectum it rose to 99½°.

The highest temperature which I have thus far observed, was 107⅖°, in a child aged two years. This was in the commencement of the attack. Subsequently it fell a little, but rose again on the third day to 107°, when she died. In two other cases the temperature was 106° on the first day, and it did not afterward reach so high an elevation. One of these died on the ninth day, and the other in the ninth week. The next highest temperature was 105⅘°, also on the first day, in an infant aged eight months, who died on the ninth day. The first and last of these cases occurred in an old wooden tenement-house in the suburbs of the city, and upon an elevated outcropping of rock. The highest temperature in any case in New York City which has come to my notice, was observed in a male patient aged twenty-eight years, who had active delirium and died on the fifth day in Roosevelt Hospital. The temperature on the last day, taken four times, was as follows: 102½°, 106¾°, and when the pulse had become imperceptible, 109° and 107¾° Wunderlich has recorded a temperature of 110° in one or two cases, but so great an elevation must be very rare, and is, of course, prognostic of an unfavorable ending.

The external temperature undergoes still greater fluctuations than the internal, rising above and falling below the normal standard several times in the course of the same day. Similar fluctuations occur in other forms of meningitis, but they are, according to my experience, less pronounced than in cerebro-spinal fever, especially as I observed them in the epidemic of 1872. Perhaps since that epidemic they have been less marked in the cases occurring in this city. The more grave the attack in those not comatose, the greater these variations. The following is a common example, in a patient aged two years. Without any notable change in other symptoms, the internal temperature varied from 101° to 104⅘° as the extremes, while that of the fingers and hands at the first examination was 90½°, at the second 90°, at the third 103°, and at the fourth 83°. Hence at the third examination the temperature of the extremities had risen 13°, so as nearly to equal that of the blood, and at the fourth examination it had fallen 20°. The patient recovered. These great and sudden variations in the pulse, and the internal and

external temperature, have considerable diagnostic value in obscure and doubtful cases.

Respiratory System.—This system is not notably involved in ordinary cases. Intermittent, sighing, or irregular respiration appears to be less frequent than in ordinary meningitis, but it does occur. In most patients the respiration is quiet, but somewhat accelerated, and without any marked disturbance in its rhythm. In thirty-one observations in children who had no complication, I found the average respirations 42 per minute, while the average pulse was 137. Therefore the respiration, as compared with the pulse, was proportionately more frequent than in health, due perhaps to the fact that certain muscles concerned in respiration, as the abdominal, are embarrassed in their movements by tonic contraction.

Various observers, in different epidemics, have recorded an unusual prevalence of croupous pneumonia occurring simultaneously with the cerebro-spinal fever. Bascome, in his history of epidemics, stated that "epidemic encephalitis and malignant pneumonias prevailed in Germany in the sixteenth century" (Webber). Webber, in his prize essay, describes a variety of cerebro-spinal fever, which he designates pneumonic, in which the cerebro-spinal axis is involved but slightly or not at all, and the brunt of the disease falls upon the respiratory organs. According to him, in certain epidemics the pneumonic form has been common and in others infrequent.

In New York City, during the epidemic of cerebro-spinal fever in 1872, pneumonia was also unusually prevalent, affecting many old as well as young people. According to the statistics of the New York Board of Health, seventeen hundred and seven deaths from diseases of the respiratory organs, exclusive of phthisis, occurred during the four months from February 1 to June 1, 1872, when the epidemic of cerebro-spinal fever was at its height, and only thirteen hundred and forty-six deaths occurred from the same diseases during the remaining eight months of the year; and as phthisis is excluded, the only other disease of the respiratory system besides pneumonia which causes a large mortality is membranous croup, which did not seem to be unusually prevalent during these four months. It is therefore probable, though not distinctly stated in the annual report of the Health Board for that year, that the great mortality from diseases of the respiratory organs, during that part of 1872 when cerebro-spinal fever was epidemic, was chiefly from pneumonia, and, according to my observations, many cases of pneumonia during that period presented symptoms of greater gravity than usually accompany this form of inflammation. The patients were greatly prostrated from the first, and in some of them febrile movement, muscular pains, restlessness, or delirium preceded for hours or even days the pneumonic symptoms, affording evidence that the lung disease occurred under certain unusual circumstances or conditions which modified its character. It is not improbable therefore that Webber's view is correct, that there are occasional cases of cerebro-spinal meningitis with pneumonia as one of its local manifestations. In the New York epidemic of 1872 a prominent citizen had a severe attack of what was supposed to be cerebro-spinal fever, one of his medical advisers being

known throughout the country for his ability in diagnosis. On the sixth day the cerebro-spinal symptoms considerably abated, pneumonia appeared, and subsequently the prominent symptoms were referable to the lungs. He slowly recovered.

Cutaneous Surface.—The features may be pallid, of normal appearance or flushed in the first days of the disease, but in advanced cases they are pallid, as is the skin generally. A circumscribed patch of deep congestion often appears, as in sporadic meningitis, upon some part of them, as the forehead, cheek, or an ear, and after a short time disappears. The hyperæmic streak, the *tache cérébrale* of Trousseau, produced by drawing the finger firmly across the surface, also appears as in other forms of meningitis, if the temperature of the surface be not too much reduced.

The following are the abnormal appearances of the skin most frequently observed: 1. Papilliform elevations, the so-called goose-skin, due to contractions of the muscular fibres of the corium. This is not uncommon in the first weeks. 2. A dusky mottling, also common in the first and second weeks in grave cases, and most marked when the temperature is reduced. 3. Numerous minute red points over a large part of the surface, bluish spots a few lines in diameter, due to extravasation of blood under the cuticle, resembling bruises in appearance, and large patches of the same color, an inch or more in diameter, less common than the others, of irregular shape as well as size, and usually not more than two or three upon a patient. These last resemble bruises, and they may sometimes be such, received during the times of restlessness; but ordinarily extravasations of this kind result entirely from the altered state of the blood. In New York, in the epidemic of 1872, they were common, but since this epidemic, in the thirty-six cases which I have observed, I have rarely seen either the reddish points or the extravasations of blood. They were probably common in the epidemics in the first part of this century in this country, since the disease was designated by the name spotted fever by the American physicians who wrote upon it at that time. That they are unusual in the European epidemics at the present time, we infer from the fact that Von Ziemssen expresses surprise that the disease should ever have been designated in America by such a title. 4. Herpes. This is common. It sometimes occurs as early as the second or third day, but in other instances not till toward the close of the first week or in the second. The number of herpetic eruptions varies from six or eight to clusters as large or larger than the hand. This cutaneous disease evidently has a nervous origin, the vesicles occurring in most instances on those parts of the surface which are supplied by branches of the fifth pair of nerves. Its most common seat is upon the lips, but occasionally it appears upon the cheek, upon and around the ears, and upon the scalp. Erythema and roseola fugitive skin eruptions occasionally appear, and in one instance in my practice erysipelas occurred. During the first days the skin is frequently dry; afterward perspirations are not unusual, and free perspirations sometimes occur, especially about the head, face, and neck.

Urinary Organs.—In other forms of meningitis it is well known that the quantity of urine excreted is usually diminished, but in this

disease it is normal, and it may be more than normal. Polyuria has been noticed in different cases by various observers. Mosler observed a boy aged seven years, who had an excessive secretion of urine, which dated back to an attack of cerebro-spinal fever in his third year. The polyuria is probably due to injury of the nervous centre, since it is established by physiological experiment that irritation of the central end of the vagus, of certain parts of the cerebellum, and of the walls of the fourth ventricle, sometimes produces this effect. The urine occasionally contains a moderate amount of albumen, and in exceptional instances cylindrical casts and blood-corpuscles.

Arthritic inflammation, apparently of a rheumatic character, has been occasionally observed. It is commonly slight, producing merely an œdematous appearance around one or more joints. Thus in one case which came under my notice, and which was subsequently fatal, the parents, who were poor, and were therefore without medical advice till the case was somewhat advanced, had already diagnosticated rheumatism on account of the puffiness which they had noticed around one of the wrists.

The Special Senses.—Taste and smell are rarely affected, so far as is known, but it is possible that they are sometimes perverted, or even temporarily lost, during the time of greatest stupor. In one case, which I saw, the sense of smell was entirely lost in one nostril, and I do not know whether it was ever fully restored.

The affections of the eye and ear are important and of frequent occurrence. Strabismus is common. It may occur at any period of the fever, continuing a few hours or several days, and it may appear and disappear several times before convalescence is established; occasionally it continues several weeks, after which the parallelism of the eyes is gradually and fully restored. In other instances it is permanent. Thus in a boy of five years, whom I last saw three months after convalescence, there were still convergent strabismus of the right eye and double vision; and in a boy of three years, convergent strabismus of the right eye remained when I examined him twelve months after the occurrence of the fever.

Changes in the pupils are among the first and most noticeable of the initial symptoms, as I have already stated in describing the mode of commencement. These are dilatation, less frequently contraction, oscillation, inequality of size, feeble response to light, etc. Most patients present one or more of these abnormalities of the pupils, and they continue during the first and second weeks, and gradually abate, if the course of the disease be favorable. Inflammatory hyperæmia of the conjunctiva often occurs. It begins early, and now and then the conjunctivitis is so intense that considerable tumefaction of the lids results, with a free muco-purulent secretion. The false diagnosis has indeed been made of purulent ophthalmia, in cases in which this affection of the lids was early and severe. But such intense inflammation is quite exceptional. More frequently there is a uniform diffused redness of the conjunctiva, not so dusky as in typhus, and the injected vessels cannot be so readily distinguished as in that disease.

In certain cases almost the whole eye (all indeed of the important

constituents) becomes inflamed; the media grow cloudy, the iris discolored, and the pupils uneven and filled up with fibrinous exudation. The deep structures of the eye cannot, therefore, be readily explored by the ophthalmoscope, but they are observed to be adherent to each other, and covered by inflammatory exudation. They present a dusky red, or even a dark color, when the inflammation is recent. Exceptionally the cornea ulcerates and the eye bursts, with the loss of more or less of the liquids, and shrinking of the eye. "But ordinarily no ulceration occurs, and, as the patient convalesces, the œdema of the lids, hyperæmia of the conjunctiva, the cloudiness of the cornea, and of the humors, gradually abate, and the exudation in the pupils is absorbed. The iris bulges forward, and the deep tissues of the eye, viewed through the vitreous humor, which before had a dusky red color from hyperæmia, now present a dull white color. The lens itself, at first transparent, after awhile becomes cataractous. Sight is lost totally and forever. This form of ophthalmia is sometimes rapidly developed, as in the following example:

On July 5, 1873, I was called to a boy, five years of age, who had reached the tenth day of cerebro-spinal fever without apparently any affection of the eyes, as both presented the normal appearance. On the following day the left eye was red and swollen from the inflammation and chemosis, so that the lids could not be closed, and the media were cloudy. Death occurred on the same day.

If the patient live the volume of the eye diminishes, as the inflammation abates, to less than the normal size, even when there has been no rupture, and escape of the fluids, and divergent strabismus is apt to occur. Professor Knapp, whose description of the eye I have for the most part followed, says: "The nature of the eye affection is a purulent choroiditis, probably metastatic." Fortunately so general and destructive an inflammation of the eye as has been described above is comparatively rare. On the other hand, conjunctivitis of greater or less severity, and hyperæmia of the optic disk, consequent upon the brain disease, are not unusual, but they subside, leaving the function of the organ unimpaired. "In some cases incurable blindness is noticed under the ophthalmoscopic picture of optic nerve atrophy, probably the sequence of choked disk." (Knapp.)

Inflammation of the middle ear, of a mild grade, and subsiding without impairment of hearing, is common. The membrana tympani, during its continuance, presents a dull yellowish, and in places a reddish hue. Occasionally a more severe otitis media occurs, ending in suppuration, perforation of the membrana tympani, and otorrhœa, which ceases after a variable time. But otitis media is not the most severe of the affections of the organs of hearing. Certain patients lose their hearing entirely and never regain it, and that, too, with little otalgia, otorrhœa, or other local symptoms by which so grave a result can be prognosticated. This loss of hearing does not occur at the same period of the disease in all cases. Some of those who become deaf are able to hear as they emerge from the stupor of the disease, but lose this function during convalescence, while the majority are observed to be deaf as soon as the stupor abates and full consciousness returns.

Two important facts have been observed in reference to the loss of hearing in these patients—to wit, it is bilateral and complete. When first observed it is, in some, as stated above, complete, but in others partial, and when partial it gradually increases till after some days or weeks, when it becomes complete. I have the records of ten cases of this loss of hearing, most of them occurring in my own practice in the epidemic of 1872, but a few of them detailed to me by the physicians who observed them in the same epidemic. According to these statistics about one in every ten patients became deaf, but in the milder form of cerebro-spinal meningitis which has prevailed since 1872, the proportionate number thus affected has been less among my patients, and the same may be said in reference to the loss of sight. One of the ten cases was a young lady, but the rest were children under the age of ten years. Professor Knapp has examined thirty-one cases. "In all," says he, "the deafness was bilateral, and with two exceptions of faint perceptions of sound, complete. Among the twenty-nine cases of total deafness, there is only one who seemed to give some evidence of hearing afterward." The same author has recently informed me that further experience has confirmed his previous statement, that while the blindness produced by cerebro-spinal fever is in the majority of cases monolateral, only one case had come to his notice in which the deafness was on one side only.

One theory attributes the loss of hearing to inflammatory lesions either at the centre of audition, within the brain, or in the course of the auditory nerves before they enter the auditory foramina. Thus Stillé says: "This symptom appears to depend chiefly upon the pressure of the plastic exudation in which the nerves are embedded." The other theory attributes the loss of hearing to inflammatory disease of the ear, and especially of the labyrinth. Dr. Sanderson, who is an advocate of the latter theory, remarks as follows: "As regards the nature of the affection, there appears to be good reason for believing that, like the blindness observed under similar circumstances, and sometimes in the same cases, it is dependent on inflammatory changes in the organ of hearing itself. Dr. Klebs was kind enough to show me, in the pathological museum of the Charité at Berlin, a preparation of the internal ear of a soldier who had died of epidemic meningitis, complicated with deafness, in which fibrinous adhesions existed between the bones of the internal ear and the walls of the vestibule. Dr. Klebs stated that in the recent state the mucous lining of the vestibule was detached." In the case of a young woman who was deaf from the commencement and died on the eighth day, "both tympani were natural, but in the left membrana tympani was found a dense white thickening as large as a pin's-head. On the same side the lining membrane of the semicircular canal was distinctly thickened and loosed, and in the anterior canal there were semifluid purulent masses." Professor Knapp also states: "The nature of the ear disease is in all probability a purulent inflammation of the labyrinth." According to him, no disease of the middle ear could cause such complete deafness; and as evidence that the deafness is not due to central disease, Dr. Gruening obtained by electrization the normal reaction of the auditory nerve within the cra-

nium. Moreover, if the lesion which destroys hearing be within the cranium, why are not the functions of the other cranial nerves also abolished? Again, Drs. Keller and Lucæ have in three post-mortem examinations found evidences of disease of the labyrinth.

An argument in support of the former of these theories is the fact that the lesion which produces the deafness is not ordinarily attended by any marked subjective symptoms referable to the ear, as otalgia, etc. Again, the fact that the deafness is nearly always bilateral and simultaneous in the two ears, comports better with the doctrine of a central lesion, than with that which locates the lesion within the ear. But the true theory can only be positively established by dissections, and, as we have seen, several post-mortem examinations have revealed inflammatory disease of the labyrinth in those who have died having this form of deafness; while in no case, so far as I am aware, has the ear been found free from inflammatory lesions. Therefore the theory which ascribes the deafness to disease of the ear is much better established than the other, and must be accepted. Moreover, most of the aurists of this city, who have had excellent opportunities to examine these cases, believe in this theory.

NATURE.—The theory that cerebro-spinal fever is a local disease, occurring epidemically, was commonly held in the first part of this century, a theory which is now discarded. Job Wilson, in 1815, considered it a form of influenza, and he could see no utility in drawing a distinction between spotted fever and influenza. We, at the present time, can see no resemblance between the two, except that both occur as epidemics. The theory that cerebro-spinal fever is a peculiar local disease occurring in epidemics is more plausible than that it is a form of influenza. Even Niemeyer says that it presents no symptoms except such as are referable to the local affection. But the evidence is strong that cerebro-spinal fever is a constitutional malady, with the meningitis as a local manifestation, just like measles with its bronchitis, or scarlet fever with its pharyngitis. The abrupt and severe commencement, unlike that of those forms of meningitis which are known to be strictly local, and the early blood change, as shown in certain cases by the appearance of the skin and extravasations under it, indicate a general disease. Constitutional diseases having prominent local symptoms and lesions are usually regarded at first as local. It is only as time goes on, and they are more thoroughly studied and understood, and clinical observations multiply, that their constitutional nature is recognized, as for example at this late day the profession are beginning to recognize the constitutional nature of croupous pneumonitis.

The theory that cerebro-spinal fever is a form of typhus once had advocates, but it is now so generally discarded, as untenable and absurd, that it would be a waste of time to consider the facts which differentiate the two maladies. Cerebro-spinal fever should, therefore, be considered as distinct from all other diseases, a malady *sui generis*, and in nosological writings it should be classified with those constitutional maladies which have specific causes.

Although this disease ordinarily occurs in an epidemic form, in localities widely separated from each other, and after continuing a few weeks

or months, totally disappears, perhaps never to return, or not till after the lapse of years, nevertheless in certain localities it becomes established, so that it is proper to describe it as an endemic, a fact to which we have already alluded as regards New York City. I do not know that it is endemic in any village or rural locality in this country, but it appears to be permanently established in certain of the large cities. The large cities, with their promiscuous population, foreigners and natives, their crowded tenement-houses, and many sources of insalubrity, furnish in an eminent degree the conditions which are favorable for the development and perpetuation of the specific principle. Those diseases which in the present state of our knowledge we have reason to believe are caused by microörganisms, we would expect to prevail most where domiciles are crowded and filthy, and systems are enervated by impure air, hardships, and privation. Hence in New York City, in the quarters of the poor, there is a constant succession of the infectious diseases of childhood. Often two or more of them occur simultaneously, and it is difficult to eradicate them or limit their extension when once they have obtained a foothold. The fact that a large city, with its tenement-house population, affords in an eminent degree the conditions in which the infectious diseases are developed and propagated, when once their specific principles have been introduced, is one of the chief causes of the large percentage of deaths among the city children. In New York what has been gained in saving life by the suppression of smallpox has been more than counterbalanced by the mortality produced by diphtheria and cerebro-spinal fever, both now to all appearance permanently established in our midst. The following table gives the number of deaths annually from cerebro-spinal fever in this city since the close of 1871:

	Number of deaths.
1872	782
1873	290
1874	158
1875	146
1876	127
1877	116
1878	97
1879	108
1880	170
1881	461
1882	238

It is seen that the greatest mortality was in the first year after the introduction of the disease into the city, after which the number of deaths gradually diminished, year by year, till 1878, when the lowest mortality was reached. Since 1878 the mortality gradually increased till 1881, in which year the number of deaths was double that of any other year except 1872, it being half that of 1872. The weather and the season appear to exert little influence on the prevalence of this disease now that it is established in the city. From the commencement of 1882 till the end of May of the current year I find that it caused deaths in every week except one, and about the same number in each of the seventeen months embraced in this period.

The mortuary reports of Philadelphia likewise show that cerebro-

spinal fever has remained in that city since its introduction in 1863, a period of twenty years, the annual deaths produced by it varying between 36, the minimum, in 1869 and 1870, and 384, the maximum, in 1864. In Providence, also, as appears from Dr. Snow's reports, cerebro-spinal fever has caused annually more or fewer deaths since 1871. Therefore, we repeat, this fact may be added to the sum of our knowledge of this disease, that once gaining a lodgement, where the conditions are favorable for it, as in a large city, it may become established and remain there an indefinite time.

Anatomical Characters.—I have notes of the post-mortem appearances in 76 cases, published chiefly in British and American journals; 29 died within the first three days, 28 between the third and twenty-first days, and the duration of the remaining 11 was unknown. These records furnish the data for the following remarks:

The blood undergoes changes which are due in part to the inflammatory and in part to the constitutional and asthenic nature of the disease. The proportion of fibrin is increased in cases that are not speedily fatal, as it ordinarily is in idiopathic inflammations. Analyses of the blood by Ames, Tourdes, and Maillot show a variable proportion of fibrin from 3.40 to more than six parts in 1000. In sthenic cases accompanied by a pretty general meningitis, cerebral and spinal, there is, after the fever has continued some days, the maximum amount of fibrin, while in the asthenic and suddenly fatal cases, with inflammation slight, or in its commencement, the fibrin is but little increased. The most common abnormal appearance of the blood observed at autopsies is a dark color with unusual fluidity and the presence of dark soft clots. Exceptionally bubbles of gas have been observed in the large vessels, and the cavities of the heart. An unusually dark color of the blood, small and soft dark clots, and the presence of gas-bubbles, when only a few hours have elapsed after death, indicate a malignant form of the disease, in which the blood is early and profoundly altered. In certain cases this fluid is not so changed as to attract attention from its appearance. The points or patches of extravasated blood which are observed in and under the skin during life in some patients usually remain in the cadaver. When an incision is made through them the blood is seen to have been extravasated not only in the layers of the skin, but also in the subcutaneous connective tissue. Extravasations of small extent are also sometimes observed upon and in thoracic and abdominal organs.

In those who die after a sickness of a few hours or days, namely, in the stage of acute inflammatory congestion, the cranial sinuses are found engorged with blood, and containing soft dark clots. The meninges enveloping the brain are also intensely hyperæmic, in their entire extent in most cadavers; but in some cases the hyperæmia is limited to a portion of the meninges, while other portions appear nearly normal. In those cases which end fatally within a few hours, this hyperæmia is ordinarily the only lesion of the meninges; but if the case be more protracted, serum and fibrin are soon exuded from the vessels into the meshes of the pia mater, and underneath this membrane, over the surface of the brain. Pus-cells also occur mixed with the fibrin, sometimes so few as to be discovered only with the microscope, but in other cases

in such quantity as to be much in excess of the fibrin, and be readily detected by the naked eye. Pus, which in these cases probably consists of white blood-corpuscles which have escaped with the fibrin from the meningeal vessels, sometimes appears early in the attack. Thus Dr. Gordon[1] relates the history of a case in which death occurred after a sickness of five hours, and a purulent greenish exudation had already occurred in places under the meninges. The exudation of fibrin also begins early. In a case of thirty hours' duration, published by Dr. William Frothingham;[2] and in another of one day's duration, published by Dr. Haverty,[3] exudation of fibrin had already occurred in and under the pia mater. The arachnoid soon loses its transparency and polish, and presents a cloudy appearance over a greater or less extent of its surface. This cloudiness is usually greatest along the course of the vessels in the sulci and depressions, and where the fibrinous exudation is greatest, but it occurs also where no such exudation is apparent to the naked eye. Dr. Gordon[4] describes a case of only eight hours' duration, in which the arachnoid was already opaque at the vertex, but of normal appearance at the base of the brain, though the vessels of the pia mater were everywhere greatly congested.

The exudation—serous, fibrinous, and purulent—occurs as in other forms of meningitis, within the meshes of the pia mater, and underneath this membrane over the surface of the brain. The fibrin is raised from the surface of the brain with the meninges. It is most abundant in the inter-gyral spaces, around the course of the vessels, over and around the optic commissure, the pons Varolii, the cerebellum, medulla oblongata, and along the Sylvian fissures. It is most abundant in the depressions, where it sometimes has the thickness of $\frac{1}{10}$ to $\frac{1}{4}$ of an inch, but it often extends over the convolutions so as to conceal them from view.

Most other forms of meningitis have a local cause, and are therefore limited to a small extent of the meninges, as, for example, meningitis from tubercles or caries of the petrous portion of the temporal bone, in both of which it is commonly limited to the base of the brain; or from accidents, when the meningitis commonly occurs upon the side or summit of the brain. The meningitis of cerebro-spinal fever, on the other hand, having a general or constitutional cause, occurs with nearly equal frequency upon all parts of the meningeal surface, except that it is perhaps most severe in the depressions, where the vascular supply is greatest. In cases of great severity the inflammatory exudation, fibrinous or purulent, or both, may cover nearly or quite the entire surface of the brain. Thus in the case of a negro, thirty-five years old, only four days sick, whose body was examined in Bellevue Hospital on May 30, 1872, the record states that there was a purulent exudation over the entire surface of the cerebrum and cerebellum. The quantity of serous exudation varies according to the duration of the disease and amount of congestion. In some the quantity is so small as scarcely to attract attention, but in other instances, especially when the disease is protracted, it is large. In a case reported by Dr. Moorman,[5] it is stated that

[1] Dublin Quarterly Journ., 1866.
[2] Amer. Med. Times, April 30, 1864.
[3] Dublin Quarterly Journ., 1867.
[4] Ibid., 1866.
[5] American Journal of the Medical Sciences October, 1866.

about three pints of turbid serum escaped from the cranial cavity in attempting to remove the brain; but as there was no measurement the statement may be somewhat exaggerated.

In those who die at an early stage of the attack, the vessels of the brain, like those of the meninges, are hyperæmic, so that numerous "puncta vasculosa" appear upon its incised surface. At a later period this hyperæmia, like that of the meninges, may disappear. If there be much effusion of serum within the ventricles, and over the surface of the brain, the convolutions are liable to be flattened, and the pressure may be so great that the amount of blood circulating in the brain is reduced below the normal quantity. Thus in the case of a child of three years, who lived sixteen days, and was examined after death by Burdon-Sanderson, the ventricles contained a large amount of turbid serum, and the brain-substance was everywhere pale and anæmic.

Cerebral *ramollissement* occurs in certain cases. At one of the examinations in Charity Hospital, the patient having been only three days sick, the brain was found much softened. The dissection was made seven hours after death, so that the softening could not have been the result of decomposition. At one of the post-mortem examinations in Bellevue Hospital, softening of the fornix, corpus callosum, and septum lucidum was observed, and in another, softening in the neighborhood of the subarachnoid space. In a case related by Dr. Moorman[1] it is stated that portions of the brain, medulla oblongata, and pons Varolii were softened. In a case observed by Dr. Upham softening of the superior portion of the left cerebral hemisphere had occurred. Occasionally the whole brain is somewhat softened. Burdon-Sanderson, Russell, and Githens each relate such a case. Moreover, the walls of the lateral ventricles are ordinarily more or less softened in fatal cases of cerebro-spinal fever, as they are in the usual forms of meningitis. In rare instances the brain is œdematous, as in a case published by Dr. Hutchinson.[2] In this case the patient was only four days sick, and the whole brain was œdematous, serum escaping from its incised surface.

The ventricles contain liquid, in some patients transparent serum, in others serum turbid and containing flocculi of fibrin, or fibrin with pus. The liquids in the different ventricles, since they intercommunicate, are the same. The choroid plexus is either injected or it is infiltrated with fibrin and pus. With the abatement of the inflammation absorption commences. The serum, from its nature, is readily absorbed, and the pus and fibrin more slowly by fatty degeneration and liquefaction. Occasionally the serum remains, and chronic hydrocephalus results. An infant who contracted the disease at the age of five months, and appeared to be convalescent, had, two months subsequently, great prominence of the anterior fontanelle, and other symptoms which indicate the presence of a considerable amount of effusion within the cranium. In another case, one year afterward, examination showed the enlargement of the head and prominence of the fontanelle which characterize chronic hydrocephalus. A boy of ten years, treated in Roosevelt Hospital in 1878, died three months after the commencement of cerebro-

[1] American Journal of the Medical Sciences, October, 1866.
[2] Ibid., July, 1866.

spinal fever. The records of the autopsy state: "Body a skeleton; brain, dura mater and pia mater appear normal, except a little thickening of latter at base of brain; ventricles much enlarged and full of clear serum; surface of walls of ventricles appears normal, but is soft; spinal cord and membranes apparently normal; heart, lungs, stomach, and intestines normal; liver congested; kidneys pale." In this case, therefore, all the other lesions of the cerebro-spinal axis, except the serous effusion, had nearly disappeared. No post-mortem examinations, so far as I am aware, have yet revealed the state of the brain and its meninges in those who have had this malady at some former time and have fully recovered, whether there may not be some traces of it which are permanent, as opacity or adhesions.

The remarks made in reference to the cerebral apply, for the most part, also, to the spinal meninges. There is at first intense hyperæmia of the membranes, usually over the entire surface of the cord, soon followed by fibrinous, purulent, and serous exudation in the meshes of the pia mater, and underneath this membrane. This exudation is sometimes confined to a portion of the meninges, more frequently that covering the posterior than anterior aspect of the cord, and when it is general it is ordinarily thicker posteriorly than anteriorly. In severe cases nearly or quite the entire spinal pia mater may be infiltrated by inflammatory products. Thus in case of an infant that died of cerebro-spinal fever at the age of ten weeks, in the service of Dr. H. D. Chapin, in the out-door department at Bellevue, the entire spinal cord was covered by a fibrino-purulent exudation, except a space about six lines in extent upon the anterior surface.

At the meeting of the New York Pathological Society, March 23, 1881, Dr. G. L. Peabody presented the specimens from the body of a patient, aged nineteen years, who died on the tenth day of cerebro-spinal fever. The exudation extended over the base of the brain, both lobes of the cerebellum, and covered completely the cord to the cauda equina, being, as usual, thickest upon the posterior surface. In some patients the spinal meningitis is severe, while the cerebral is slight, so that the symptoms referable to the spinal axis predominate, such as pain in the back and limbs, and opisthotonos. The exudation may have the usual appearance of fibrin and pus, but it is sometimes greenish and sometimes blood-stained. Small extravasations of blood also occur as a result of the hyperæmia, and in one case related by Burdon-Sanderson it is stated that there was a layer of blood one-eighth of an inch thick over the whole cord below the bronchial swelling. In post-mortem examinations the central canal of the cord has usually been overlooked. Ziemssen relates a case, and Gordon another, in which it was dilated and filled with purulent fluid. The anatomical changes which have been observed in the cord itself have been injection of its vessels in recent cases, and occasional softening of portions. Thus in a case which was examined in Bellevue Hospital, April 13, 1872, it is stated that there was softening of the cord in the upper part of the dorsal region. In most of the examinations the only abnormal appearance detected in the cord was hyperæmia, but in a considerable proportion of cases the records state that the substance of the cord appeared normal.

Professor Wm. H. Welch, of Johns Hopkins University, has recently communicated to me the following results of his examinations when curator to Bellevue Hospital:

"I have records of eight autopsies which I have made upon cases of cerebro-spinal meningitis, and in six cases I have examined, microscopically, portions of the hardened brain and cord. Post-mortem rigidity is usually well marked and continues for a long time after death. Upon removal of the skull-cap, which is often hyperæmic, the dura mater appears tense, and usually more or less congested. The sinuses contain loose, dark red coagula, and some fluid blood. In one case I found a recently formed grayish-red ante-mortem thrombus in the left lateral sinus. The subdural space is usually free from inflammatory exudation, but occasionally a slight fibrino-purulent exudation is found on the outer surface of the arachnoid membrane. The pia mater is generally hyperæmic, and frequently it contains small ecchymoses. An exudation is present in the subarachnoid spaces, over both the convexity and the base of the brain, most abundantly, as a rule, at the base. Over the convexity the exudation appears in the form of greenish-yellow streaks along the veins between the gyri. At the base the exudation accumulates in the subarachnoid cisterns, such as those of the Sylvian fissure, of the optic chiasm, of the intercrural space, of the under surface of the cerebellum, and along the basilar artery. The cranial nerve-trunks may be enveloped in a purulent exudate as they emerge from the brain. The fluid in the ventricles may or may not be increased in amount, but is usually turbid from admixture of pus-cells. The choroid plexuses are often swollen and opaque.

"The substance of the brain is usually hyperæmic, and frequently contains punctate ecchymoses, which may occur in groups. Small foci of softening may be formed before death, but extensive diffuse softening, particularly that around dilated ventricles (hydrocephalic softening) is probably cadaveric, and due to imbibition of serum, although it may form within a short time after death.

"The inflammatory exudation occupies likewise the subarachnoid space over the cord. The exudation may surround the posterior nerve-roots for a distance from the cord. Microscopic examination shows that the exudation is composed of serum, fibrin, pus-cells, and red blood-corpuscles. Usually the exudation is distinctly purulent, being of a greenish-yellow color, but it may be predominantly serous in character. The pus-cells are accumulated around the small veins and capillaries. I have found the ependyma of the fourth ventricle richly infiltrated with pus-cells, which here as well as elsewhere are probably emigrated white blood-corpuscles. The connective tissue cells of the pia-arachnoid membrane are swollen and granular. The lymph spaces around the blood-vessels in the cerebral cortex are often filled with pus-cells. The communication between these perivascular spaces and the subarachnoid spaces renders easy the passage of wandering cells from the pia mater into the cortex. There may also be found an increased number of lymphoid cells in the perigangliouic spaces. In a similar manner the sheaths of the bloodvessels and the pial processes in the spinal cord may be invaded by pus-cells.

"In one of my cases the symptoms of the disease are said to have existed for only twelve hours before death. Here there was an excess of serum in the cerebral and spinal subarachnoid spaces. The serum was moderately turbid. The microscope showed a more abundant exudation of pus-cells than there appeared to be from the gross appearances. The substance of the brain was pale and œdematous, nor was there marked congestion of the meninges."

No constant or uniform lesions occur in the organs of the trunk, and those observed are not distinctive of this disease. Hypostatic congestion of the lungs, bronchitis, atelectasis, and broncho-pneumonia are common. Pleuritic, endocardial, and pericardial inflammations have occasionally been observed, but are rare. Effusion of serum, sometimes blood-stained, occasionally occurs in the pleural and other serous cavities. The auricles and ventricles of the heart, as already stated, contain more or less blood, with soft dark clots in the more malignant and rapidly fatal cases, but larger and firmer in those which have been more protracted. The spleen is enlarged in less than half the patients. The absence of uniformity as regards the state of the spleen, the fact that in many it undergoes no appreciable change, is important, since this organ is so generally enlarged and softened in the infectious diseases. The stomach, intestines, and liver are sometimes more or less congested, but in other cases their appearance is normal. The agminate and solitary glands of the intestines have ordinarily been overlooked, but in certain cases they have been found prominent. The kidneys in some exhibit the lesions of nephritis. In one of the eight autopsies made by Professor Welch acute diffuse nephritis had been present, as shown by the state of the kidneys. In the case of a child of nine years, treated by Dr. F. A. Burrall, in the Presbyterian Hospital, the urine was very albuminous and the kidneys presented a fatty appearance. Anatomical changes in these organs, however, are not common, unless in slight degree, so that in most patients their function is fully and properly performed.

Prognosis.—Cerebro-spinal fever is justly regarded as one of the most dangerous maladies of childhood. It is dreaded not only on account of the great mortality which attends it, but on account also of its protracted course, the suffering which it causes, the possible permanent injury of the important organ which is chiefly involved, and the not infrequent irreparable damage which the eye and ear sustain.

I have the records of the result in 52 cases which I attended or saw in consultation in the epidemic of 1872. Of these just one-half recovered. Sixteen of the twenty-six who died were hopelessly comatose within the first seven days, most of them dying within that time, and some even on the first and second days, while others of the sixteen lingered into the second week and died without any sign of returning consciousness. The remaining ten, who subsequently died, but did not become comatose in the first week, were nevertheless seriously sick from the first day, but their symptoms, though severe, were not such as necessarily indicated a fatal result, so that there was some expectation of a favorable ending till near death, which occurred for the most part from asthenia. One succumbed to purpura hæmorrhagica, the hemorrhages occurring from the mucous surfaces, and who died after a

sickness of more than two months, in a state of extreme emaciation and prostration. The twenty-six who recovered convalesced slowly and usually after many fluctuations. Their highest temperature and most severe and dangerous symptoms occurred in the first week. Most of them were several weeks under observation and treatment before they sufficiently recovered to be out of danger. The statistics of this epidemic therefore show, and the same is true of other epidemics, that the first week is the time of greatest danger, and if no fatal symptoms are developed during this week recovery is probable with proper therapeutic measures and kind, intelligent, and efficient nursing, the latter of which is very important.

Since the epidemic of 1872 I have treated, or seen in consultation, 35 cases that I was able to follow to the close, most of them in the last four years. Of these 19 recovered and 16 died. Of the 16 fatal cases 8 died in the first week, 5 in the second week, 1 on the twenty-fifth day, 1 on the thirty-first day, and 1 in the sixteenth week. This last patient, a boy of ten years, would, in my opinion, have recovered with better nursing. His death occurred from large bedsores which extended to the bones, produced, though attended by his mother, by lying a long time in one position on a hard bed, when he was too weak to move, and often with soiled bedclothes underneath him.

There is probably no disease which falsifies the predictions of the physician more frequently than cerebro-spinal fever. This is due partly to the severity of the cerebral symptoms in the commencement, which, did they occur in other forms of meningitis with which he is more familiar, would justify an unfavorable prognosis, and partly to the remissions and exacerbations, the occurrence alternately of symptoms of apparent convalescence and recrudescence or relapse, which characterize the course of this malady. Grave initial symptoms, which may appear to have a fatal augury, are often followed by such a remission that all danger seems past, and in a few hours later, perhaps, the symptoms are nearly or quite as grave as at first.

Under the age of five years, and over that of thirty, the prognosis is less favorable than between these ages. An abrupt and violent commencement, profound stupor, convulsions, active delirium, and great elevation of temperature, are symptoms which should excite solicitude and render the prognosis guarded. If the temperature remain above 105° death is probable, even with moderate stupor. Numerous and large petechial eruptions show a profoundly altered state of the blood, and are therefore a bad prognostic, and so is continued albuminuria, since it shows great blood change, or nephritis, while other organs than the kidneys are probably also involved. In one case, a boy, whom I examined nearly a year after the cerebro-spinal fever, the kidneys were still affected. He had anasarca of the face and extremities, with albuminuria. Chronic Bright's disease had occurred from the acute nephritis, which complicated cerebro-spinal fever. Profound stupor, though a dangerous symptom, is not necessarily fatal so long as the patient can be aroused to partial consciousness and the pupils are responsive to light; so long as it does not pass into actual coma it is

less dangerous than active or maniacal delirium, which is apt to eventuate in this coma.

A mild commencement, with general mildness of symptoms, as the ability to comprehend and answer questions, moderate pain and muscular rigidity, some appetite, moderate emaciation, little vomiting, etc., justify a favorable prognosis, but even in such cases it should be guarded till convalescence is fully established.

We may repeat and emphasize the important fact shown by the above statistics, that patients who live till the close of the second week without serious complications will probably recover. The danger after this period is, in most instances, from exhaustion and feeble action of the heart, resulting from the impaired nutrition and protracted course of the disease.

Complications, which most frequently pertain to the lungs, increase greatly the gravity of many cases and contribute to the fatal ending. The fact that Webber, in his prize essay, describes a variety of cerebro-spinal fever which he designates pneumonic, and that those who make post-mortem examinations find that "œdema, hypostatic congestion of the lungs, bronchitis, atelectasis, and broncho-pneumonia, are extremely common lesions in cerebro-spinal meningitis" (Welch), indicates a source of danger in addition to that located in the cerebro-spinal system. One close observer of an epidemic writes: "In all the fatal cases which came under my notice, the most prominent symptoms which preceded death were those which indicate impairment and perversion of the respiratory functions. As the breathing became more hurried and difficult, the general depression became more intense, the pulse became weaker and quicker, and the temperature of the skin more elevated."

Parenchymatous degeneration of the liver and kidneys is another serious complication. The kidneys are probably more frequently, and to a greater extent, diseased than the liver. Acute diffuse nephritis was present in one of the eight cases examined after death by Prof. Welch. In the *Revue Médicale* for June 3, 1882, M. Ernest Gandier published the case of a female who died comatose on the sixth day of cerebro-spinal fever. Examination of the urine had revealed the presence of "retractile albumen of Prof. Bouchard, attributable to renal lesions, and non-retractile albumen, considered as an indication of some general infection of the system." Microscopic examination of the kidneys "showed considerable swelling and granular degeneration of the renal epithelial cells, with effusion of granular matter within the lumen of the tubules. We have seen from the case alluded to above that the renal complication may persist and become chronic. Those who fully recover often exhibit symptoms usually of a nervous character, as irritability of disposition, headache, etc., for months after convalescence is established.

DIAGNOSIS.—Cerebro-spinal fever, on account of the nature and severity of its symptoms and the suddenness of its onset, may be mistaken for scarlet fever, and *vice versâ*. In one instance, to my knowledge, this mistake was made. High febrile movement, vomiting, convulsions, and stupor, are common in the commencement of scarlet fever, and the same symptoms commonly usher in the severer forms of cere-

bro-spinal fever. It will aid in diagnosis to ascertain whether there be redness of the fauces, for this is present in the commencement of scarlet fever, and in a few hours later the characteristic efflorescence appears on the skin.

The diagnosis of cerebro-spinal fever from the common forms of meningitis is ordinarily not difficult, for while in the former the maximum intensity of symptoms occurs in the first days, in the latter there is a gradual and progressive increase of symptoms, from a comparatively mild commencement. Moreover, cases of ordinary or sporadic meningitis occurring at the age when cerebro-spinal fever is most frequent, are commonly secondary, being due to tubercles, caries of the petrous portion of the temporal bone, or other lesion, and are therefore preceded and accompanied by symptoms which are directly referable to the primary disease. We have seen how different it is in cerebro-spinal fever, which in most patients begins abruptly in a state of previous good health. Again, in cerebro-spinal fever, after the second or third day, hyperæsthesia, retraction of the head, and other characteristic symptoms occur, which are either not present or are much less pronounced in ordinary meningitis. Some of the milder cases of cerebro-spinal fever might be mistaken for hysteria, but the pain in the head and elsewhere, muscular rigidity, and especially the occurrence of more or less febrile movement, enable us to make the diagnosis. Continued fever, typhus or typhoid, resembles cerebro-spinal fever in certain particulars, but it lacks the muscular contraction and rigidity which characterize the latter. It does not usually begin so abruptly, with such severe symptoms, especially such severe headache, has less marked fluctuations, and a more definite duration. These facts, in connection with the character of the prevailing epidemics, will enable us to make the diagnosis. In one instance commencing retro-pharyngeal abscess, probably associated with vertebral caries, was at first mistaken by me for cerebro-spinal fever. The patient was an infant, had a temperature of 104°, stiffness of the neck with some retraction of the head, and cried from pain when the head was brought forward. The speedy occurrence of two large abscesses in other parts of the system, difficult deglutition and noisy respiration, led to a digital exploration of the fauces, when the abscess was found and lanced.

Treatment.—Since in epidemics of cerebro-spinal fever cases are more frequent and severe where anti-hygienic conditions exist, it is evident that measures looking to the removal of such conditions, measures designed to procure pure air in the domicile, wholesome diet, and a quiet and regular mode of life—in fine, measures designed to produce the highest degree of health—are of the first importance for the prevention of the disease. Cleanliness of the streets and areas, as well as apartments, perfect sewerage and drainage, the prompt removal of all refuse matter, avoidance of over-crowding; in a word, the strict observance of sanitary requirements in every particular, will, there can be little doubt from what we know of the causation and nature of cerebro-spinal fever, diminish the number and severity of the cases. The avoidance of fatigue and overwork, of mental excitement, the use of plain and wholesome diet, sufficient sleep, the utmost regularity in the mode

of life with the least possible exposure to depressing agencies, are the important preventive measures which should be recommended wherever an epidemic of cerebro-spinal fever is occurring.

It is probable that the young man who, still weak from an attack of typhoid fever, applied himself closely to his business, of a perplexing nature, which had suffered from his absence, and in a few days was seized with headache and vomiting, and soon died of this malady, would have escaped by a more prolonged rest, and less mental excitement and worriment. It has seemed to me that those children whose cases are embraced in my statistics, that left home in the morning entirely well, and when engaged in their studies, subject to the noise and discipline of the public schools, which is often too severe and rigorous for sensitive children, were attacked with this disease, would probably have escaped in the quiet of their own homes. The girl that, failing of promotion in her school, returned home crying, and closely applied herself to her studies till she was compelled to desist by the severe headache which ushered in cerebro-spinal fever, perhaps would have remained well had her experiences in the school been more pleasant and less depressing. In a similar manner the two children that were attacked with cerebro-spinal fever immediately after mild punishments which they had received, but which produced mental excitement, perhaps would have escaped under less severe family discipline.

The enjoining of a quiet and regular mode of life as a preventive measure, during the occurrence of an epidemic of cerebro-spinal fever, is not inconsistent with the theory that the cause is a microörganism. It is not unreasonable to suppose that the system may be more or less under the influence of the specific principle, that this principle may obtain lodgement in the blood or tissues without result until some exciting cause occurs which depresses the system and disturbs the functions, when the resisting power fails and cerebro-spinal fever appears; just as those exposed to Asiatic cholera may remain well until some imprudence in the diet or the mode of life causes an outbreak of the malady.

Curative Treatment.—In the commencement of cerebro-spinal fever, intense inflammatory congestion occurs of the cerebral and spinal meninges, and also to a certain extent of the brain and spinal cord. As regards treatment, the obvious indication is to reduce the hyperæmia of the vessels as quickly as possible and subdue or diminish the inflammation. For this purpose bags or bladders of ice should be immediately applied over the head, and to the nucha, and constantly retained there as long as there is no complaint of chilliness, no marked diminution of temperature, and the patient experiences some relief from the intense headache and other symptoms. Bran mixed with pounded ice produces a more uniform coldness and is sometimes more agreeable to the patient than the ice alone. The bag or bags should be about one-third full, so as to fit upon the head like a cap, and the nurse should be instructed to renew the ice as soon as it melts. In severe cases, with marked elevation of temperature, it is proper to apply cold over the dorsal and lumbar vertebræ, as well as upon the head and nucha. A hot mustard foot-bath or a general warm bath in those cases in which convulsions

are present or threatening, or there is delirium or great agitation or severe peripheral pains, is also useful, since it has a calmative effect and acts as a derivative from the hyperæmic nerve-centres. One writer states that he obtained marked benefit in a case by immersing the body to the neck in hot water.

The abstraction of blood, usually by leeches applied to the temples, behind the ears, or along the spine, has been employed, but even in the commencement of the present century, when it was customary to bleed generally and locally in the treatment of inflammatory and febrile diseases, a majority of the American physicians whose writings are extant discountenanced the use of such measures in the treatment of this disease. Drs. Strong, Foot, and Miner, though under the influence of the Broussaian doctrine, were good observers, and they soon abandoned the use of the lancet and leeches in the treatment of these patients for more sustaining measures. Strong[1] states that certain physicians employed venesection as a means of relieving the internal congestions, but finding that the pulse became more frequent after a moderate loss of blood, they soon laid aside the lancet. Some experienced physicians of that period, however, continued to recommend and practise depletion, general as well as local, as, for example, Dr. Gallop, who treated many cases in Vermont, in the epidemic of 1811.

Venesection in the treatment of cerebro-spinal fever is universally discarded at the present time in this country and in Europe, but some intelligent physicians, as Sanderson and Niemeyer, approve of local bleeding in certain cases. It is, in my opinion, after examining the histories of many cases, uncertain whether the abstraction of blood should ever be recommended, but if it be prescribed, it should be on the first day, when the hyperæmia is greatest, by the application of only a few leeches behind the ears, and never except when convulsions or coma are present or threatening, and the patient is robust. The fact should not be forgotten that cerebro-spinal fever is in its nature asthenic and protracted, and that the intense inflammatory congestion of the nervous centres can ordinarily be relieved, if relieved at all, by the other measures recommended, which do not reduce the strength. The alarming symptoms which usher in an attack, the intense headache, restlessness, delirium, sometimes eclampsia or coma, seem to demand the most energetic treatment, and yet it is surprising to one who has his first experiences with this malady how patients under proper treatment, without the abstraction of blood, emerge from an apparently almost hopeless state and ultimately recover. There may be total unconsciousness, the pupils dilated like rings and insensible to light, the head intensely hot, tonic convulsions present or alternating with frequent clonic convulsions, and yet these symptoms, which in any other disease would be regarded as sufficient to justify the prognosis of certain death, may gradually pass off toward the close of the first or in the second week, and the case afterward progress favorably. In the New York epidemic of 1872, previously to which physicians of this city had no personal experience with cerebro-spinal fever, many cases were pronounced hopeless which ultimately did well without abstraction of blood. In a case occurring in

[1] Medical and Physiological Register, 1811.

the practice of Dr. Griswold the patient was comatose for three days, with pupils not responding, or but very feebly responding to light, but he recovered without the abstraction of blood, and with the remedies ordinarily employed. In a case which we will presently relate, in speaking of another local treatment, the patient was still insensible in the third week, with pupils greatly dilated and insensible to light, and yet recovered without losing blood. Such cases show that the most urgent symptoms, such as seem to indicate the prompt employment of leeches in order to reduce the meningeal hyperæmia and the consecutive congestion of the nerve-centres, may be relieved and the patient recover without such depletion, and with the preservation of the blood, which is so much needed in the subsequent asthenic course of the malady.

In only one case have I recommended the abstraction of blood, and this was so instructive that I will briefly relate it: A girl, four years of age, was seized on March 7, 1873, with vomiting, chilliness, and trembling, followed by severe general clonic convulsions lasting about fifteen minutes; was semi-comatose; pulse 132, and a few hours later, 156; temperature 101¼°; respiration 44; eyes closed, pupils moderately dilated and feebly responsive to light, dusky mottling of skin, constant tremulousness with twitching of limbs. Bromide of potassium was administered in hourly doses of four grains, ice applied to the head and nucha, and a hot mustard footbath followed by sinapisms to the nucha. On the following day, March 8th, she was partly conscious, when aroused, but immediately relapsed into sleep, head retracted, bowels constipated; pulse 136; temperature 102°; vomits occasionally. It was thought proper, on account of the extreme stupor, to apply one leech to each temple and the bites trickled slowly nearly five hours. The other treatment was continued. On the 9th the pulse was 180, so feeble that it was counted with difficulty; temperature 101½°. The patient was evidently sinking. It was necessary to order whiskey in teaspoonful doses every two hours, with beef-tea and other most nutritious drinks. Evening, pulse 172, still feeble. March 10th, pulse 180, barely perceptible; great hyperæsthesia; axillary temperature 100°; axes of eyes directed downward. After this the patient gradually rallied for a time, the pulse becoming stronger and less frequent, but death finally occurred after nine weeks in a state of extreme emaciation and exhaustion. Slight convulsions occurred in the last hours.

It is seen that in the above case, which may be regarded as typical, the patient passed into a state of extreme prostration after the application of the leeches, so that for three days I did not believe that she would live from hour to hour, and death occurred after an illness of nine weeks, apparently from sheer exhaustion. Experience like this, which corresponds with that of most other observers, shows the necessity of preserving the blood and thereby the strength, however urgent the initial symptoms, inasmuch as cerebro-spinal fever in its subsequent course is attended by such marked asthenia. On May 3, 1878, a boy of ten years was admitted into one of our best hospitals, in the service of a prominent New York physician. It was stated that he had been four days sick with cerebro-spinal fever, and among other characteristic symptoms he had had delirium every night and on May 2d delirium in the daytime, which

had abated considerably after free epistaxis. In the hospital the application of ten leeches along the spine was ordered, but it does not appear to have diminished the delirium or any other symptom, and on the following day the pulse was so frequent and feeble that active stimulation by brandy was resorted to. He had three strong convulsions on May 13th, which were relieved by ice to the head and nape of neck, and by six minims of Magendie's solution. Severe pains occurred at times in the back and limbs, and on the 29th, one month after the commencement of the disease, the same pain frequently recurring, twelve leeches were ordered to be applied to the spine. On June 2d the limbs were flexed and quite stiff, and the effort to move them was attended by great pain. The pain in the back was also more constant, and in consequence sixteen leeches were applied to the spine. The next day there was no pain, but the patient was very stupid. On June 6th the records state that he was obviously losing strength day by day, that his emaciation was extreme and his anæmia very marked. But he had great vitality, and although he had strabismus, bedsores, incontinence of urine and feces, and extreme prostration, he lingered till August 1st. At the autopsy, "body, a skeleton; brain, dura mater, and pia mater appear normal, except a little thickening of latter at base of brain; ventricles much enlarged and full of clear serum; surface of walls of ventricles looks normal but is soft; spinal cord and membranes appear normal to the naked eye." No disease was discovered in other organs, except that the liver appeared congested and the kidneys pale. It can scarcely be doubted that, although some temporary relief from the pain may have resulted to this patient by the repeated application of leeches, which diminished the meningeal hyperæmia, yet his chances for ultimate recovery would have been far better without such depletion. Therefore the histories of cases show that the result of abstraction of blood has been unsatisfactory, on account of the asthenic nature and protracted course of cerebro-spinal fever, and it should be very rarely, if ever, recommended as a remedial agent.

Some benefit is apparently derived from the application of stimulating and moderately irritating lotions along the spine. A liniment consisting of equal parts of camphorated oil and turpentine briskly applied by friction with flannel up and down the spine till redness is produced, appears to cause some alleviation of the suffering and it does not conflict with the use of the ice-bag. Dr. William H. Sutton, of Dallas, Texas, has published the following interesting case, showing the benefit from stimulating and irritant applications over the spine made in an unusual manner. A child, aged three and one-half years, had been three weeks under treatment, through error of diagnosis, for supposed continued fever. When Dr. Sutton assumed charge of the case on November 20, 1877, the pupils were greatly dilated and insensible to light; features pallid and pinched; pulse 130; temperature 103°; patient totally unconscious. November 21st, morning temperature 105°; pulse 140; evening temperature 101¼°; pulse 120. November 22d, morning temperature 106½°; pulse 160; restless; evening temperature 105½°; pulse 120; had not slept except for moments for nearly two weeks. A strip of flannel saturated with turpentine was

placed over the spine from the neck to the sacrum, and a hot smoothing iron was run up and down it, and eight drops of the fluid extract of ergot were given every three hours. Dr. Sutton adds: "The father stated to me that as soon as the application was finished the child fell asleep, and slept several hours—the first for two weeks—and the fever rapidly declined. From this time he began to improve and gradually and fully recovered. The use of irritating applications over the spine in the treatment of cerebro-spinal fever has been long and favorably known, but the mode of applying it practised in the above case is novel.

INTERNAL TREATMENT.—It will aid in the selection of the proper remedies to recall to mind the pathological state which we know to be present from the many autopsies which have been recorded. We have seen that the largest mortality, and consequently the most dangerous period, is in the first days, when there is intense suddenly developed inflammatory congestion of the meninges, with more or less secondary hyperæmia of the underlying brain and spinal cord, producing great headache, delirium, or somnolence, with exaggerated reflex irritability of the spinal cord, so that eclampsia is a common and fatal complication.

Fortunately a remedy has been discovered in modern times, the bromide of potassium, which acts promptly and efficiently. It can be safely administered in large and frequent doses to the youngest child. It is quickly eliminated from the system through the kidneys and other emunctories in children, so as to prevent the occurrence of bromism, at least to the extent of causing any unpleasant consequences. It causes contraction of the minute vessels of the nervous centres so as to diminish the hyperæmia, as shown by the experiments and observations of Dr. Putnam-Jacobi and others, and at the same time it diminishes, in a marked degree, the reflex irritability of the spinal cord, two most beneficial and important effects of its use in this disease. Many children by its timely employment are saved from the dangers of eclampsia, and by its sedative effect on the nervous system and contractile action on the capillaries it probably diminishes the intensity of the inflammation and the amount of exudation. I usually prescribe it, as recommended by Dr. Squibb, dissolved in simple cold water. In ordinary cases not attended by eclampsia or marked symptoms which show that eclampsia is threatening, I usually prescribe at my first visit about four grains every two hours to a child of two years, who has the usual restlessness and apparent headache, and six grains to a child of five years. If eclampsia occur, the bromide should be given more frequently, as every five or ten minutes till it ceases. It is important to be able to determine when the quantity of the bromide administered should be diminished, and when its use should be discontinued. I have very rarely observed bromism in children, and never to the extent of doing any serious harm, though for many years I have administered it in large and frequent doses whenever the occasion seemed to require it, but the symptoms of bromism cannot readily be discriminated from those which may result from cerebro-spinal fever, such as muscular weakness, dilated pupils, with perhaps impaired vision, unsteady gait, nausea or vomiting, and abdominal pains. If the case progress favorably, frequent and large doses

should, in my opinion, be given only in the first week, after which this agent should be given at longer intervals, or in smaller doses. But during exacerbations, which are liable to occur from time to time till the patient is well on the way to recovery, the use of the bromide in full doses is again indicated till the urgent symptoms begin to abate.

Ergot is another very important remedy. It is scarcely less useful than the bromide, from its known action in contracting the arterioles and diminishing the flow of arterial blood. The fluid extract, tincture, or wine of secale cornutum can be employed, or its active principle ergotine. In this city Squibb's fluid extract has been more used than any other preparation. I have commonly prescribed it except for patients old enough to take ergotine in the pill. The doses employed by different physicians vary greatly. Dr. William A. Thomson, Professor of Materia Medica in the New York University, has prescribed, so far as I am aware, the largest doses in the treatment of this disease, to wit, one teaspoonful of the fluid extract of secale cornutum every three hours to a boy of ten years in Roosevelt Hospital in 1878, with apparent benefit as regards the meningeal hyperæmia, although the case was fatal after the lapse of several months from asthenia. The alkaloid ergotine, to which the beneficial effects of the secale cornutum are due, may be given in the pill or in solution. In case of much irritability of the stomach it can be employed hypodermically, dissolved in water with glycerine. The efficacy of this agent is most marked during the first and second weeks, when the congestion of the nervous centres is greatest. At a more advanced stage, when there is less congestion and the danger arises from the inflammatory products and structural changes, the time for the use of ergot is passed, or if it is still of some service it is less needed than at first and should be given less frequently.

The severe headache and restlessness which attend many cases, require the occasional use of an opiate, or the hydrate of chloral. Chloral in proper dose never fails to give quiet sleep, and it is supposed by some who have studied its therapeutic action that it diminishes the cerebral circulation. It is therefore an useful adjuvant to the bromide. Five grains usually suffice for a child of six to eight years. Chloral is especially useful in cases attended by eclampsia, or symptoms which threaten eclampsia, since it acts promptly and decidedly in diminishing reflex irritability. Formerly it was considered injudicious and unsafe to prescribe opiates in meningeal inflammation, since it was supposed that they increased the liability to coma, but experience shows that they are sometimes very useful in this disease when administered in small or moderate doses, and without the risk which was once supposed to be incurred by their use. The thirty-second part of a grain of morphia administered at intervals of some hours was sufficient to relieve the suffering of one of my patients at the age of six years.

Quinia apparently does not exert any marked controlling effect on the course of cerebro-spinal fever or its symptoms, although the paroxysmal character of the severe pains in many patients suggests the use of this agent as an antiperiodic. It was frequently prescribed by New York physicians in the epidemic of 1872, but I believe that the opinion was unanimous that it was not the proper remedy. I have prescribed it in

large and small doses, in one instance giving fifteen grains to a child of thirteen years, but do not know that I have derived any benefit from its use in this malady.

When the acute stage has abated, measures designed to remove the serum which sometimes remains, constituting a hydrocephalus, are indicated. For this purpose the iodide of potassium is probably more useful than any other agent. It is administered by some physicians early, along with the bromide, as they have been in the habit of treating other forms of meningitis. I have prescribed it with the bromide, and alone when the bromide was discontinued, but whether it produces a sorbefacient effect in this disease seems to me doubtful.

The result depends to a great extent on the nursing. The skill of the physician may be thwarted and the life of the patient lost by inefficient nursing. No other disease more urgently requires kind, intelligent, and constant attendance night and day on the part of the nurses. Not only should the medicines and nutriment be given punctually and regularly, but the great restlessness of the patient in the first days requires constant readjusting of the ice-bags, and during the long period of convalescence the utmost care is required to remove at once the excretions in order to prevent bedsores, and to give the proper amount and kind of nutriment to prevent the emaciation and weakness from which many perish. Among my cases are those who owed their recovery largely to the untiring devotion of mothers. The one that died of bedsores I have little doubt would have recovered had the nursing been such as some of the others received.

The diet, from the beginning to the end of the malady, should be the most nutritious, and such as is easily digested. It is necessary to give it in the liquid form, unless in mild cases in which the appetite may not be entirely lost. It is proper to aid the digestion by pepsine preparations. Nutritive enemata, consisting of beef-tea, or Leube's extract of beef, milk, and brandy, aid in averting the fatal prostration in protracted cases. After the acute stage has passed by and the meningeal hyperæmia has abated, the alcoholic compounds in moderate doses, which in the beginning would be very injurious, may now be useful, administered regularly by the mouth. The room should be dark, well ventilated, and quiet. All sympathizing friends who are not required in the nursing should be excluded. I know no other disease in which this is so necessary, for mental excitement may produce dangerous aggravation of symptoms. Recently a young lady, to whom I made one visit in consultation, and whose recovery seemed probable, was allowed to receive the visit of a young gentleman. Immediately after his departure her headache was intensified, the symptoms became generally aggravated, and the result in a few days was fatal.

CHAPTER V.

ACUTE RHEUMATISM.

Rheumatism is a constitutional disease with a local manifestation, to wit, inflammation of the sero-fibrous tissues, chiefly in and around the articulations, but occasionally in the heart. It was formerly supposed to be rare in children, but more accurate observations show that it is scarcely less common during childhood than in adult life. In young patients, especially under the age of six or eight years, it is frequently overlooked, for the articular inflammations in such patients are commonly slight. In the last fifteen years, during my connection with the children's class in the Bureau for the Relief of the Outdoor Poor, I have examined many children with rheumatism or the cardiac lesions resulting from rheumatism, and ordinarily I have found that few joints were affected, and that there had been but little swelling of them, or redness, and that the patients were almost never confined to bed, or even to the sitting posture, but had been able to walk about, though with restraint and complaint of pain or soreness. The parents in many instances supposed that their children were suffering from "growing pains," as they designated them. At the same time, with this mildness of symptoms, the heart was becoming seriously and permanently crippled, by endocarditis. Those who have attended my clinics will recollect that on some days as many as three or four children with cardiac lesions have been present whose histories showed an overlooked rheumatism of this mild type. Cases like the following are very common among the city poor:

In January, 1871, a little girl, three years old, was presented, having distinct aortic direct, and mitral regurgitant murmurs. The mother was not aware that she had had rheumatism, but at the age of twenty months she had for several days pretty active febrile symptoms, which the physician attributed to some other ailment. In April, 1871, another girl, of the same age, was brought to the clinic, having a distinct mitral regurgitant murmur. The mother stated that she had been well till a month previously, when she was confined to her bed for a few days, having a high fever. She was attended by a homœopathic physician, and the exact character of her sickness the mother was not able to state. Further medical advice was sought, as the child remained delicate, though her health was better than at first. There can be little doubt that the obscure fever in this case was rheumatic. In another child treated elsewhere, not old enough to relate the subjective symptoms, there was, in addition to an intense fever, evident pain in one foot or leg, when the limb was moved. Still, the nature of the disease was not diagnosticated till some time after recovery, when a valvular murmur was accidentally discovered. Such histories, which are not rare show that rheumatism

often occurs in young children, even infants, and they inculcate the important practical lesson, that the disease at this age may be so obscure, or latent, as to be overlooked even by good diagnosticians.

Some observers, meeting cases of valvular disease in children, without the history of rheumatism, have concluded that rheumatism is not the chief cause of endocarditis at this age;[1] but the explanation which I have given seems to me more in consonance with the facts. Scarlet fever not infrequently causes endocarditis, but this exanthem seldom occurs without detection, and it has been as often absent as has rheumatism from the histories as given by the parents of young children with valvular disease, whom I have examined. Moreover, the endocarditis of scarlet fever is in many cases associated with, if it do not result from, scarlatinous rheumatism.

Rheumatism in children is primary or secondary. The secondary form occurs chiefly in the declining stage of scarlet fever and variola. It is stated, also, to occur occasionally in newborn infants during epidemics of puerperal fever, but I have not observed such cases.

Causes.—An inherited rheumatic diathesis is universally recognized as an important predisposing cause of this disease, so that it frequently occurs in different members of the same family. When the family history shows a strong predisposition to rheumatism, it occurs in the child from a slight exciting cause; if no such predisposition exist, it only occurs through unusual circumstances of exposure. The ordinary exciting cause is the same as in most idiopathic inflammations, to wit, exposure to cold; but a strong rheumatic diathesis appears to be sufficient in itself to produce an outbreak of the disease. Children who have had one attack are especially liable to another.

The morbific principle in the blood which produces the phenomena and lesions of rheumatism, is supposed to be lactic acid, a theory which originated with Prout, and is strengthened rather than weakened by observations since his day. According to this theory, lactic acid sustains the same causative relation to acute rheumatism as uric acid to gout, and, as Prof. Austin Flint states, it receives support from the fact that the lactic acid treatment of diabetes may produce rheumatic inflammation of the joints.

Symptoms.—The commencement of acute idiopathic rheumatism is in most cases sudden; occasionally fever, and a degree of soreness or stiffness, precede the articular affection for a few hours or days. The inflammation, slight at first, increases gradually, attaining its maximum intensity within one or two days. The joint is painful, red, hot, and swollen. The swelling is due to inflammatory œdema of the tissues surrounding the joint and effusion within the joint. As in all inflammations, the vascularity of the parts involved is increased, the synovial membrane loses, more or less, its lustre, and the effused fluid, which is mainly serum, has been found, in most of the cases in which an opportunity was presented to examine it, to contain, like the pleuritic exudation, a few globules of pus. Rarely, in a reduced state of the system, so much pus is produced within the joint as to constitute a true abscess, and rarely also fibrin is exuded, producing a rubbing sensation when

[1] Dr. A. Steffen, Jahrbuch für Kinderh., 1870.

the joint is moved, and endangering permanent adhesion of the articular surfaces. Fortunately, however, in the vast majority of cases, the substance exuded both without and within the joint is mainly serum, and hence the rapid subsidence of the swelling when the inflammation ceases. The pain is commonly not severe when the child is quiet, but it is greatly increased if the joint be pressed or the limb moved.

The joints of the extremities are most frequently the seat of rheumatic inflammation, but occasionally those of the trunk, as the intervertebral, the symphysis pubis, etc., are involved. As the inflammation abates in the articulations first affected, it reappears in others, unless the materies morbi have been eliminated from the system. It is seldom that more than two or three of the joints are in a state of active inflammation at the same time.

The temperature in acute rheumatism is elevated two or three degrees above that of health, and the pulse varies from 120 to 140, its frequency depending on the age of the patient, as well as the gravity of the disease. Perspiration is a common symptom. The appetite is impaired, the tongue slightly coated, and the bowels constipated. The watery element in the urine is diminished, as in most febrile diseases, and there is not a corresponding reduction in the solid elements, so that the urine is rendered more dense, and its specific gravity is high. The amount of urea and coloring matter excreted from the kidneys is augmented during the active period of rheumatism, and the urine, when it cools, deposits urates. In ordinary cases there is no prominent symptom referable to the nervous system, with the exception of pain in the affected joint.

Acute rheumatism, if only the articulations were involved, would be a disease of little danger, however painful, but unfortunately in its proneness to produce specific inflammation of the sero-fibrous tissues, the heart frequently becomes involved, less frequently the lungs and pleura, and in rare instances the cerebral or spinal meninges. Endocarditis is the most frequent of the heart inflammations occurring in rheumatism; pericarditis, though less common, is not infrequent, while in rare instances myocarditis occurs, usually associated with the other inflammations. Endocarditis is limited to the left side of the heart, and seldom continues long without engaging the valves, aortic or mitral, or both, causing their infiltration, fibroid degeneration, with consequent thickening, and sometimes adhesion. The valvular lesion thus produced is in most instances permanent, so impairing the action of the valves as to obstruct in greater or less degree the flow of blood through the orifice and allow its regurgitation.

The mitral valve is more frequently affected than the aortic, at least *bruits* produced by this lesion are more frequent in the mitral than aortic orifice, and when they are heard in both orifices they are commonly loudest in the mitral. This fact, noticed by different observers, I have repeatedly verified by observations in this city.

While the articular affections pertain to the clinical history of rheumatism, the internal inflammation, whether of the heart, lungs, pleura, or meninges, though similar as regards its pathological character, is properly considered as a complication. Acute rheumatism is so frequently complicated by one or the other of these affections, that any

disproportionate severity in the general symptoms, as compared with the inflammation of the joints, or any sudden and unexpected increase in the symptoms, should always lead the physician to examine thoroughly the condition of those organs which are most frequently affected.

Inflammatory complications occur, as a rule, during the active period of rheumatism, when the inflammation is passing from joint to joint. If the general symptoms begin to improve, and no new joints are involved, the liability to complications is greatly diminished. Secondary rheumatism, occurring in most instances in connection with certain eruptive fevers, especially scarlatina, commonly affects only a few joints, often only one or two, as the wrist, and, though painful, is attended by slight swelling and redness.

Duration—Prognosis.—With proper treatment and without complication the febrile action in a few days begins to abate, and the disease commonly terminates within two weeks Its duration is ordinarily shorter than in rheumatism of the adult. Fluctuations, however, are liable to occur. The disease may appear to be abating, and the articular inflammations nearly cease, when they return for a time, often without new exposure and without appreciable cause. The prognosis, even when cardiac inflammation has supervened, is in most cases favorable, except so far as the lesion resulting from this inflammation is concerned, which being permanent may entail much subsequent suffering, and occasion death after months or years. Indeed, what is most to be dreaded in cases of acute rheumatism is valvular disease or pericardial adhesion with its remoter consequences, namely, hypertrophy of heart, congestion and œdema of lungs, dropsies, etc.

Fig. 23.

Secondary rheumatism occurring in scarlet fever is sometimes also complicated with or, rather coexists with, cardiac inflammation, pleuritis, or pneumonitis, rendering the prognosis more unfavorable.

In rare instances the acute symptoms of rheumatism abate, but the joints remain stiff and more or less swollen, and painful when moved. The acute has lapsed into a subacute or chronic rheumatism. Such a case, represented in the accompanying figure, was brought to the children's class in the Outdoor Department at Bellevue Hospital, in February, 1871. E. H., a female, 3½ years old, had intermittent fever from the age of nine to fifteen months. From this time she remained well till the age of two years, when she was taken with acute rheumatism, commencing in her ankles and extending to other joints. The knee and hip joints on both sides have only partially recovered their mobility, and both legs and both thighs are permanently flexed, so that the gait is slow and unsteady. It is impossible to straighten either limb without causing great pain, and attempts to straighten the thigh produce the arch in the back very similar to that in coxalgia.

Diagnosis.—This is not difficult in ordinary cases, if a proper examination be made. In the commencement, if the affection of the joints be slight, rheumatism might be mistaken for remittent, typhoid, one of the eruptive fevers, or meningitis; but, on careful examination, tenderness of one or more of the articulations will be observed, and probably some swelling. This tenderness is readily distinguished from the hyperæsthesia which is common in the first stage of the essential fevers, and which is observed when pressure is made upon the chest or abdomen as well as upon the limbs, and is more marked between the joints than in them. Any doubt which may at first exist, whether the patient may not have one of those diseases, is soon dispelled, since their clinical history presents notable differences from that of rheumatism.

I have known scrofulous arthritis, or scrofulous ostitis near the joint, present so close a resemblance to acute rheumatism as to be at first mistaken for it. In one instance this inflammation commenced nearly simultaneously in three joints, rendering the diagnosis at first very difficult. But scrofulous inflammation, as well as that from pyæmia, can be diagnosticated from rheumatic disease of the joints, by its greater persistence, less induration and symmetry in the swelling, and by the history of the case. Chronic rheumatism may produce deformity similar to that from chronic scrofulous inflammation, as in the case mentioned above, but the rheumatic history, number of joints affected, bilateral character of the inflammation, good general health, etc., are sufficient to establish a clear diagnosis, when the disease has been observed for some days.

Treatment.—The theory of the pathology of a disease determines the mode of treatment, and the theory that rheumatism is due to an acid in the blood, probably lactic, though not established, has been widely received, and has led to the extensive employment of alkalies, as tartrate of sodium and potassium, acetate of potassium, etc. The alkaline treatment apparently materially abridges the duration of acute rheumatism; but lately a new remedy, namely, salicylic acid, has been found to act almost as a specific in a large proportion of cases, quickly relieving the pain, and subduing the inflammation, so that a few days suffice to effect a cure. Speedy cure of this malady is urgently demanded, on account of the imminent peril to the heart. Children are very liable to the cardiac complication. Although salicylic acid frequently causes the disappearance of all symptoms within a week, they are apt to reappear unless the medicine be continued in occasional doses for some days subsequently, as I have had opportunity to observe. It should be prescribed with an alkali, as in the following formula, which is similar to one employed in the Outdoor Department at Bellevue:

℞.—Acid. salicylic. . . . . ℥ij–iij.
Potas. acetat. . . . . ℥ss.
Glycerinæ . . . . . ℥j.
Aquæ . . . . . q. s. ad ℥v.—Misce.
Give one teaspoonful every three hours to a child of six years.

A new remedy, producing useful therapeutic effects, is apt to be prescribed at first for too many distinct pathological states, till finally its use is restricted to such conditions as it is found to relieve. Salicylic

acid has undergone this trial, and, while it has been rejected as a remedy for the infectious diseases, it is recognized as the most useful of all remedies for the disease which we are now considering. An occasional opiate, as Dover's powder, may also be needed between the doses of the acid.

An eligible mode of prescribing salicylic acid is in the salicylate of sodium, which is very soluble and not so unpleasant to the taste as salicylic acid in combination with most other bases. It is used more than any other preparation of salicylic acid in New York, and much more than any other remedy for the treatment of acute rheumatism, and ordinarily with a good result. It may be administered in a formula like the following:

℞.—Sodii salicylat. . . . . ℥ij.
Syr. bal. tolut. . . . . ℥ij.
Aquæ . . . . . ℥vj.
Dose, a dessertspoonful every two or three hours to a child of five years.

Recently I employ the following formula, since the oil of wintergreen contains a considerable amount of salicylic acid:

℞.—Ol. gaultheriæ . . . . . ʒj.
Sodii salicylat. . . . . ℥iij.
Syr. simplic. . . . . ℥iij.
Aquæ . . . . . ℥vj.—Misce.
Dose, a dessertspoonful to a child of five years.

During the declining period of rheumatism and in convalescence quinine or some preparation of cinchona should be employed and the above medicine given less often. This tonic does indeed appear to exert a beneficial effect on the course of rheumatism, and it is employed by some judicious and experienced physicians from the commencement.

If there be a high temperature and a quick pulse, quinine administered in an occasional large dose will be found very useful. Three to five grains may be given to a child of five years.

Rheumatism impoverishes the blood, and the patient often begins to present an anæmic appearance, when he requires iron in addition to the vegetable tonic. The citrate of iron and quinine may then be employed.

Secondary rheumatism requires sustaining treatment from the first. Such cases ordinarily do well without anti-rheumatic treatment, with the general supporting measures employed for the primary disease.

Pneumonitis complicating rheumatism is best treated by moderate counter-irritation and emollient poultices, and the internal use of carbonate of ammonium or quinine. In pericarditis or endocarditis, if, as is commonly the case, the movements of the heart be accelerated, aconite or the tincture or infusion of digitalis, is demanded to the extent of reducing the number of pulsations to near the normal frequency. A child of six years can take three drops of the tincture or a large teaspoonful of the infusion, to be repeated, if necessary, in three hours, till the required reduction of the pulse is effected. Patients often experience relief, by the use of this agent, from the palpitation and dyspnœa consequent upon the embarrassed movements of the heart. If the heart disease be severe and pulse feeble, quinine is also useful.

The patient should be kept quiet, in a room of uniform temperature, and not exposed to draughts of air. By such precautions the danger of complications is greatly diminished. Repellant applications, as cold or irritants, should not be applied to the joints, so long as the disease is acute, for they also increase the danger of complications. The affected joints should be enveloped in flannel or cotton, and the pain, if intense, may be diminished by applying flannel wrung out of warm water. If the disease become subacute or chronic, if the urates have disappeared from the urine, and the inflammation cease to pass from joint to joint, the tincture of iodine, or moderately stimulating embrocations, applied to the joints, involve no danger and are useful.

CHAPTER VI.

ERYSIPELAS.

The term erysipelas is applied to a constitutional or blood disease, which is characterized by inflammation of the skin and subcutaneous connective tissue, and by a tendency to spread. It is accompanied by pungent and pricking heat, swelling, and subcutaneous infiltration.

In rare instances, in young infants, an inflammation which has been designated erysipelas occurs in and around the umbilicus. It commences about the time of the detachment of the umbilical cord, and is accompanied by redness of the skin and tumefaction, with induration of the connective tissue surrounding the umbilicus. It usually causes ulceration of the umbilical fossa, and, in fatal cases, pus is sometimes found in the umbilical vessels. This disease does not show any tendency to spread; the diameter of the inflamed surface is not more than three or four inches, with the umbilicus at the centre. It is generally fatal; but two favorable cases have been reported to me, in one of which there was considerable ulceration, and after recovery a firm cicatrix occupied the site of the umbilicus. The most reasonable view is that this disease is primarily an inflammation of the umbilical fossa and vessels, induced by uncleanliness, cachexia, or other cause. It lacks the distinguishing feature of erysipelatous inflammations, namely, the tendency to spread, and I shall, therefore, take no further notice of it in this connection. (See Diseases of the Umbilicus.)

Erysipelas occasionally occurs in childhood; the cases which are met in this period present nearly the same features, and pursue nearly the same course, as in the adult. In infancy, erysipelas is a common disease, and the following remarks relate chiefly to erysipelas occurring in this period of life. They are based on data derived mainly from the records of cases which occurred in this city, some in my own practice,

and others in the practice of physicians known to be good observers. The points of chief interest in forty-one cases are embraced in the following table:

Cases of Infantile Erysipelas.

No	Sex.	Age.	Point of Commencement	Parts Affected.	Duration.	Result.
1	M.	5 months.	Right knee.	Entire surface, except face and scalp	5 weeks and 3 days.	Recovered.
2	M.	2 years.	Left knee.	From a little above the knee to the ankle.	7 days.	Recovered.
3	M.	10 months.	Elbow.	Whole arm and forearm.	.....	Recovered.
4	F.	20 months.	Below right knee	Entire leg, thigh, and trunk to the umbilicus	7 days.	Recovered.
5	F.	9 months	Vulva.	Abdomen, chest, and all the extremities	18 days.	Recovered.
6	M.	9 days.	Genitals.	Both lower extremities, abdomen to the umbilicus.	6 days.	Died.
7	F.	1 year.	Vulva.	Entire surface, except face.	6 weeks.	Recovered.
8	F.	6 weeks.	At or near the ear	Forehead and side of face.	1 week.	Died in tetanic spasms.
9	..	9 months.	Epigastric region	Trunk and lower extremities.	2 weeks.	Died in tetanic spasms.
10	F.	10 months	At angle of mouth.	Entire face and scalp.	10 days.	Recovered.
11	F.	4 weeks.	Vulva.	Entire surface, except face.	3 weeks.	Died.
12	F.	3 months.	Vulva.	Surface of abdomen to umbilicus and right lower extremity.	2 weeks.	Recovered.
13	F.	4 to 5 mos.	Vulva.	All the limbs and trunk, except the chest.	3 to 4 weeks	Died.
14	F.	5 months.	From syphilitic sores around anus.	Trunk and both lower extremities.		
15	F.	3 months.	Vulva.	Entire trunk and both upper extremities.	3 weeks.	Recovered.
16	M.	8 months.	Face near nostrils	Entire trunk and both upper extremities	About 2 weeks.	Recovered.
17	F	4 months.	Vulva.	Entire trunk and all the extremities.	1 week.	Died.
18	F.	7 months	Knee.	A portion of trunk and both lower extremities.	3 weeks.	Recovered.
19	F.	6 months.	Near the ear.	Entire face and forehead.	10 days.	Recovered.
20	M.	7 days.	Left eyelid.	Left side of face.	3 days.	Died.
21	M	14 days.	Genitals	Extended to knee, over abdomen to the chest.	4 days.	Died.
22	M.	3 months	Under the chin.	Chin, left cheek, neck, left side of trunk, left thigh and leg.		
23	F	28 months.	Right shoulder.	Arm and forearm.	1 day.	Died in convulsions.
24	F	3 or 4 days.	Vulva.	Body and all the limbs.	12 days.	Died.
25	F.	3½ mos.	Under left ear.	Neck, chest, and arms.	About 2 weeks.	Died.
26	..	7 months.	Below right knee	Trunk, neck, and head, and all the limbs.	2 weeks.	Died comatose.
27	F	6 months	Vulva.	Both thighs, and nearly entire trunk.	3 days.	Died comatose.
28	M.	19 months.	Near point of vaccination.	Shoulder, arm, and forearm.	21 days.	Recovered.
29	M.	4 months.	Near point of vaccination.	Chest, and both upper limbs.	2 weeks.	Recovered.
30	F.	2 months.	Near vaccine vesicle.	Trunk, and all the limbs.	10 days.	Died.
31	..	3 to 4 mos.	Near vaccine vesicle.	Arm, forearm, and shoulder on one side	2 to 3 weeks	Died.
32	F.	4 months.	Near vaccine vesicle	Arm, forearm, and trunk.	2 months.	Died.
33	M.	2 months.	Near vaccine vesicle.	Nearly entire surface.	1 week.	Died with peritonitis.
34	M.	5½ mos.	Near point of vaccination	Arm and forearm.	.....	Recovered.
35	M.	2½ mos.	Near point of vaccination.	Arm.	7 days.	Died probably of peritonitis
36	M.	8 months.	Near vaccine vesicle.	Arm and forearm.	17 days.	Died.
37	..	5 months.	Left foot.	Leg, thigh, and lower part of trunk.	2 weeks.	Died with pneumonitis
38	..	5 weeks.	At one ear.	Entire surface.	2 weeks.	Recovered.
39	..	2 months	Left leg.	Trunk, and all the limbs.	2 weeks.	Recovered.
40	..	4 months.	Near point of vaccination.	Trunk, and all the limbs.	2 weeks.	Died.
41	M.	14 months.	Face.	Trunk, and all the limbs.	4 weeks.	Recovered.

Age.—Of the above cases, 27 were under the age of six months; 9 from six months to twelve, and only 5 above the latter age. A large majority, therefore, of cases of infantile erysipelas occur in the first year of life.

Point of Commencement.—In 58 cases in which I have ascertained the point of commencement, it was in 13 cases the vulva, 17 the arm after vaccination, 7 the leg, 6 the face, 3 the male genital organs, 3 at or near the ear, 1 the elbow, 1 the shoulder, 1 the nates, 1 the foot. In the adult, idiopathic erysipelas commonly commences upon the face, and affects only the face, ears, forehead, and scalp. On the other hand, in infantile erysipelas, statistics show that the rash commences upon the face only in a small proportion of cases, one in nine, and that it rarely extends to the face when it commences in other parts.

Causes.—In erysipelas the first departure from the healthy state occurs in the blood, or the system generally. This undergoes certain changes which predispose to erysipelas, or are sufficient in themselves to give rise to it. Among the causes which produce this state of system, uncleanliness, residence in damp, dark, and crowded apartments, and defective alimentation, hold a principal place. Hence this disease is more common in the poor quarters of a city than in the country, and in dispensary and hospital than in family practice.

In a large proportion of cases there is a local exciting cause of infantile erysipelas, to wit, an irritation or inflammation at some point, generally trivial, but which is sufficient to develop the disease in the system already prepared for it. It commonly commences at or near a simple ecthymatous or impetiginous eruption, around burns or suppurating sores or syphilitic eruptions; it frequently commences, as is seen by the above table, near the point of vaccination immediately after vaccination, or when the pock is developed, or again when it has run its course and been detached. In a considerable proportion of cases it begins at a point where the skin is thin and delicate, or where it unites with a mucous surface, probably from some uncleanliness or irritation of those parts. Thus, I have records of cases in which it commenced at the external ear, commissure of the mouth, and at the vulva. Indeed, the frequency with which it commences at the vulva renders female infants more liable to it than males. In some instances erysipelas begins without any local exciting causes, upon smooth and sound skin, even when there are sores upon various parts of the surface.

Vaccination, as an exciting cause of erysipelas, demands particular notice. Often, doubtless, it is the inflammation which necessarily arises from the cut or the vesicle, which operates as an exciting cause of the erysipelatous affection, and not any deleterious property contained in the virus which is employed, so that an equal degree of inflammation occurring in any other way, as from a burn, would be attended by a like result. But facts show that the virus itself occasionally contains a latent noxious principle, which, introduced into the system, operates as a cause of erysipelas. Thus, a little girl was vaccinated by me in November, 1860, and about the time when the vesicle began to fill she was seized with severe inflammation of the fauces, attended by tumefaction and infiltration of the submucous connective tissue. The inflam-

mation rapidly subsided, and within a week from its commencement the throat affection had nearly or quite disappeared. I now believe that the disease of the fauces was erysipelatous, although it was not suspected at the time to have this character.

As the girl was otherwise healthy, and the vaccine vesicle passed through its usual stages, and presented the usual appearance, the scab was employed six weeks afterward to vaccinate two infants. Within twenty-four hours after vaccination both these infants were seized with high fever, ushering in severe erysipelas, commencing in one around the point of vaccination, and in the other around syphilitic sores near the anus. In the former case the erysipelatous rash extended from the shoulder over the entire limb, and was obstinate, twice reappearing, and extending over the same surface; in the latter (a mulatto child) it extended over both lower extremities and a considerable part of the trunk, when the case passed into the hands of another physician, and the result is not known. The instrument with which the vaccinations were performed was clean. The vaccine disease did not appear in either of these cases.

Again, a well-known physician of this city vaccinated three infants, one his own (No. 32 of the table), with part of a scab which had been pronounced good, but was taken from a child that he had not seen, and with whose state he was not familiar. These infants were all affected with erysipelas from the vaccination, his own dying. He had taken the precaution to rub the lancet on his boot before using it. Another physician of his city has informed me that he vaccinated two children in the same family with a scab, with all the precautions that he ever had used, and both were soon after affected with erysipelas of a severe form, extending from the point of vaccination; the vaccine disease did not appear. I have heard of no case in which the vaccine lymph gave rise to erysipelas, and probably it rarely or never does. In the lymph there is no admixture of foreign substances, whereas in the scab there is a large proportion of animal matter.

There is a form of erysipelas which occurs in the infant immediately after birth, and which is sometimes met in private practice, but is most frequently observed as an epidemic in lying-in-wards. It is associated with severe, and commonly fatal, puerperal or septic fever, or erysipelas of the mother. This form of erysipelas is fatal, almost without exception, and its contagiousness is generally admitted by those who have had opportunity to observe cases.

A case showing the relation of erysipelas in the newly born infant to disease of the mother occurred in the practice of Dr. Leaming, of this city. A woman gave birth to a healthy infant, on the 27th of July, 1860. A few days subsequently she was seized with a chill, followed by erysipelas, commencing on the thighs, and terminating fatally August 17th. As no autopsy was allowed, the state of the internal organs was not ascertained. A few days before her death the same disease commenced on the infant. It extended around the neck, upon the ears, down the arms, and terminated fatally August 24th. But erysipelas in the newborn infant, occurring in connection with erysipelas in the mother, is more rare than its occurrence with puerperal fever.

The records of lying-in asylums furnish many examples of epidemics of puerperal fever, in which the infants of affected mothers perish of erysipelas.

The late Dr. Folsom, of this city, furnished me the following sketch of cases which occurred in his practice and that of his partner: "About the year 1840, being then in practice in New Bedford, Mass., I was called to visit a man who complained of pain in the knee. The next morning he was easier, but the following evening his symptoms grew worse, and as I was engaged in a case of obstetrics, my partner, Dr. E. C., now dead, visited him. At my call, next morning, I unexpectedly found the patient dying. The disease was obscure, and at the autopsy next day no lesion was discovered. In making the examination, Dr. C. pricked his finger, and experiencing little inconvenience from it at first, he attended a case of confinement on the following morning. A few hours subsequently he was taken sick, and I took charge of the lady, who died in three days, having the tumid abdomen and symptoms of childbed fever. The infant of the patient was seized, when two days old, with erysipelas, appearing on the face and in spots on the trunk and limbs, and terminating fatally in one day. Dr. C.'s finger became swollen and painful, and the lymphatics of the forearm and arm became inflamed, presenting red lines, and the axillary glands suppurated. Though feverish and much prostrated, there was no appearance of erysipelas in his case. In about two weeks he resumed practice, and as at that time physicians in this country were not fully aware of the danger of communicating puerperal fever, he attended two, three, or four obstetrical cases each week, until the number reached fifteen. All the mothers died with symptoms of metro-peritonitis, and all the infants had erysipelas, commencing on the face or some part of the body, generally on the second or third day after birth, and in all terminating fatally within a week. This sad record was finally ended by the doctor's temporarily retiring from practice."

Dr. Condie[1] says: "Erysipelas of infants very commonly occurs during the prevalence of epidemic puerperal fever. Children of mothers who become affected with the fever are often born with erysipelatous inflammation; others are attacked almost immediately after birth. Whether, in these cases, the disease is to be referred to a morbid matter applied to the skin in the womb, or to the same epidemic or endemic influence which gives rise to the disease of the parent, it is difficult to say. According to M. Trousseau, infantile erysipelas is principally observed when puerperal fever prevails in the wards of the lying-in hospitals at Paris." In private practice it is rare that we meet erysipelas of the infant associated with erysipelas or with puerperal fever in the mother. Some of the oldest physicians of this city, with whom I have conversed, and who are engaged in extensive general practice, state that they have never met a case in which there was this relation. Cases like those observed by Drs. Folsom and Leaming only occur when epidemic erysipelas or puerperal fever is prevailing.

According to Ziegler, erysipelas is produced by a micrococcus which

[1] Treatise on Diseases of Children.

enters the lymphatics and spreads chiefly by them. They are found in immense masses, or swarms, in the lymphatics, and from them they spread into the tissues, where they excite inflammation and often tissue necrosis.

Premonitory Symptoms.—Infantile erysipelas in certain cases has no premonitory stage, or, if present, it escapes notice. In other instances there are well-marked precursory symptoms, as drowsiness, or restlessness, febrile movement, oppressed respiration, with perhaps vomiting, and starting or twitching of the limbs. In Cases 28 and 37 of the table, which occurred in my practice, the febrile movement, restlessness, and oppressed respiration were so great for three days before the appearance of the eruption, as to cause much anxiety. In the adult, pharyngitis often precedes the occurrence of the rash upon the skin. The same inflammation may be present in the premonitory period of infantile erysipelas, as well as during the period of erysipelatous eruption. The hurried and difficult respiration which is present in the commencement of some cases, is probably due to an erysipelatous turgescence of the bronchial mucous membrane.

Symptoms.—The patient with this disease is usually restless, in consequence of the burning pain which accompanies the eruption. In severe cases there is little sleep, night or day, except from medicine. The sleep is short, and is often interrupted by sudden starting or twitching of the limbs. Convulsions may occur, but are not common.

Febrile movement is constant, and is proportionate to the extent and gravity of the erysipelas. I have notes of cases in which the pulse was more than 200 per minute, although other symptoms did not indicate immediate danger. The skin not affected by erysipelas is dry and hot, though not possessing the pungent heat of the inflamed portion; face often flushed; tongue moist, and covered with a light fur; stomach usually retentive. The state of the bowels varies; sometimes they are regular; sometimes variable, while in other cases the stools are green, and more frequent than natural. I have records relating to the state of the bowels in twenty cases, as follows: in seven, regular; in nine, loose; in two, constipated; in one, constipated, then loose; and in one, constipated, then regular. Diarrhœa, when present, is usually mild, requiring little or no treatment. The erysipelatous redness is not in all cases so pronounced as in the adult, but otherwise there is nothing peculiar in its appearance. In feeble infants, with an impoverished state of the blood, its color is pink, instead of the deep red which characterizes the inflammation in the robust. Points of vesication may occur where the inflammation is most severe, as in the adult, and subsequently the same desquamation and œdema.

If the infant be debilitated, there is great danger of the formation of abscesses, around which the inflammation lingers after it has disappeared from every other part of the body. Sometimes also, in very young infants gangrene occurs, especially in the genital organs in the male. Several of these cases have been related to me, all under the age of a month or six weeks, and all fatal. Occasionally the sloughing is so great as to denude the testicle. A noteworthy feature of erysipelas in infants is its proneness to return. When it has been progressively

subsiding, and hope is entertained of its speedy disappearance, it not infrequently is suddenly relighted from some unknown cause, travelling again over the same, or parts of the same surface. In one case the disease, arising from vaccination, extended three times over the arm and forearm; and in another case, a second time over both legs and a considerable part of the trunk.

The internal inflammations which most frequent complicate erysipelas, and give rise to symptoms which are superadded to those pertaining to the erysipelas, are pharyngitis and peritonitis; and more rarely bronchopneumenia or enteritis. In a case which I examined after death, in the Nursery and Child's Hospital, and in which the erysipelatous inflammation having extended over the abdomen, the lesions of peritonitis were present, it appeared, from the thinness of the abdominal walls, that the inflammation had extended through the parietes from the external to the internal surface.

Prognosis.—Erysipelas is much more fatal in infancy than in adult life. In the death statistics of this city for three years, I find eighty deaths from erysipelas of infants under the age of one year, to eighty-three deaths from this disease above that age. Age greatly influences the prognosis. Infants under the age of three weeks usually die; from the age of three weeks to six months the result is doubtful; while above the age of six months a majority recover with correct treatment. It will be seen by the foregoing table that seven infants under the age of six weeks had erysipelas, and six died; from the age of six weeks to six months, six recovered and nine died; and above the age of six months, nine recovered and four died.

With the exception of a case of the so-called umbilical erysipelas, the youngest child who recovered, of whom I have obtained information, was three weeks old. In this case the rash extended nearly over the entire surface, beginning with the face. Case 38 of the table, treated by myself, was very similar as regards the extent of the erysipelatous eruption and the result. This infant was five weeks old.

It is scarcely necessary to state that erysipelas is more favorable when it affects the limbs than when it invades the head, neck, or body; when it spreads slowly than rapidly; when it is superficial than when phlegmonous. In those cases in which the connective tissue is much involved, the infant is not always safe after the disease has run its course; he sometimes dies exhausted from the discharge of abscesses; I have records of two such cases.

Duration.—In sixteen cases that recovered, the erysipelas terminated within the first week in two, the second week in six, the third week in five, fourth week in one, and in two cases it lasted five and six weeks. The average duration was fifteen days. In nineteen fatal cases, ten died within the first week, five the second week, three the third week, and one in the fourth week. The average duration of fatal cases was about ten days.

Modes of Death.—Death occurs in different ways; in clonic or tonic convulsions followed by coma, from exhaustion, and from internal inflammation; that from exhaustion being probably the most common.

Pathological Anatomy.—The blood doubtless in this disease under-

goes certain pathological alterations previously to the occurrence of the eruption, but the exact changes are not known. Our knowledge of the morbid anatomy of erysipelas relates chiefly to the local affections, which, with the exception of the inflammation of the skin, are not constant, and may, therefore, be regarded as complications. The cutaneous inflammation affects all the structures of the skin, and in greater or less degree also the subcutaneous connective tissue. The inflammation is accompanied by more or less serous effusion or œdema.

The not infrequent occurrence of peritonitis in connection with erysipelas has long been known. In Heberden's *Epitome Morborum Puerilium*, the anatomical character of erysipelas is expressed in one sentence: "When the body has been opened after death, the intestines have been found glued together and covered with coagulable lymph." Since Heberden's time, nearly all who have written on diseases of infancy and childhood have mentioned peritonitis as one of the most common complications. Underwood says: "Upon examining several bodies after death, the contents of the body have frequently been found glued together and their surface covered with inflammatory exudation, exactly similar to that of women who have died of puerperal fever." Similar remarks in reference to the frequency of peritonitis in this disease are made by recent writers.

The statistics in reference to erysipelas as well as peritonitis show that in infants in hospital practice, and in those affected by erysipelas during epidemics of puerperal fever, peritonitis is a not infrequent complication. On the other hand, as we commonly meet cases of infantile erysipelas occurring sporadically in private practice, abdominal distention and tenderness are not sufficient to indicate peritonitis In only one of the cases embraced in the foregoing table was a post-mortem examination made, and in that there had been no peritonitis. The occurrence of pharyngitis in connection with erysipelas has been already mentioned.

Enteritis has been alluded to as another complication in infants. Diarrhœa has been stated to be a symptom in certain cases, and it has been found to be dependent on enteritis of a mild grade. Billard made post-mortem examinations of sixteen infants who died of erysipelas, and "found in two gastro-enteritis, in ten enteritis, in three pneumonia complicated with enteritis and cerebral congestion, and in one pleuro-pneumonia."

Treatment.—On this side of the Atlantic great uniformity prevails as regards the treatment of erysipelas. Sustaining measures are prescribed, and the tincture of the chloride of iron is the tonic generally preferred. Whatever the intensity of the febrile reaction and the stage of the disease, if there be no intestinal complication, ferruginous or other tonics should be administered. The largest doses of the tincture of the chloride of iron given in any of the cases in the above table were in case No. 4, namely, ten drops every two hours, and this patient recovered in seven days from a pretty severe attack. Probably, however, nothing is gained by such large doses, and they may irritate the intestinal surface, and increase the liability to enteritis, which, we have seen, complicates a certain proportion of cases. Four drops may be given every three

hours to a child from one to two years of age. Instead of the iron, or in addition to it, one of the preparations of cinchona may be prescribed. Beef-tea, and wine-whey or other alcoholic stimulant, are required.

The depressing measures recommended by certain writers cannot be too strongly censured. One author says: "We should endeavor from the first to allay the inflammation of the skin by energetic treatment. . . . Local abstraction of blood, by means of one or two leeches applied at the circumference of the primary seat of the erysipelas, should be put in force, provided the power of the constitution of the children permits." Such treatment may explain one of this author's aphorisms, namely, *the erysipelas of infants is a fatal disease.*

Local treatment may be employed to arrest the extension of the inflammation, but the result in most cases is not encouraging. Solid nitrate of silver was employed in two cases of which I have records, and in both the result was pernicious. Troublesome sores were produced, from which blood escaped, and in one of the cases, at least, death was attributed by the parents to this treatment, rather than to the disease.

Tincture of iodine is a better remedy for arresting the extension of erysipelas. It should be applied from the margin of the inflammation, over the sound skin, to the distance of about two inches. It may be ineffectual, but it does not produce any unfavorable result. Soothing applications, like rye flour, or a lotion of sugar of lead, may be made to the inflamed surface, as in erysipelas of the adult. I prefer, however, for local treatment, the constant application of vaseline or glycerine and water, to which carbolic acid is added—one to ten.

PART III.

SECTION I.

DISEASES OF THE CEREBRO-SPINAL SYSTEM.

Diseases of the brain and spinal cord are less frequent than those of the respiratory and digestive systems. They are also less amenable to treatment, and are much more fatal. They largely increase the aggregate of deaths. They contrast with the diseases of the other systems in their greater relative frequency in infancy and childhood than in adult life. This is explained, as regards the brain, by the rapid development and active molecular change in this organ in early life, its great impressibility by the emotions, and the thinness of the covering which protects it from external agencies.

Some of the most interesting of the cerebro-spinal diseases which are to engage our attention, are peculiar to early life, as tetanus infantum. The diseases of this system also contrast with other local affections in their greater obscurity, especially in their commencement; for, while maladies of the thorax can be readily ascertained by auscultation and percussion, or those of the abdomen by the nature of the evacuations or the degree of tenderness or distention, our means of conducting examination through the bony encasement of the cerebro-spinal axis are meagre and unsatisfactory. The condition of the brain and spinal cord must be determined, chiefly, by the study of symptoms, and not by direct examination. The condition of the anterior fontanelle in young infants, however, enables us to determine the presence or absence of active congestion of the brain. If there be an excess of arterial blood, it is convex. Prominence of the fontanelle is common in inflammatory and febrile diseases, and is a sign of considerable diagnostic and prognostic value.

Within a few years, the ophthalmoscope has been employed as a means of diagnosis in cerebral diseases, and although the employment of this instrument for such purpose is but recent, enough has been elicited to prove its value as an aid in determining the state of the brain. Prof. H. D. Noyes remarks on this subject: . . . "The argument for making ophthalmoscopic examination in all cases of brain disease, becomes irresistible. Indeed, a moment's reflection would lead to this conclusion without any considerations drawn from pathology. The optic nerve is only an outlying portion of the brain; its extremity is fully exposed to view. Situated within about two inches of the brain, it is the only nerve in the body which we can inspect; it contains

bloodvessels which communicate directly with the intracranial circulation. We thus come into relation with the cerebrum, by continuity of nerve-structure and also of bloodvessels."

Structural changes in the optic nerve and retina have been discovered by means of the ophthalmoscope in meningitis, hydrocephalus, phlebitis of the sinuses, apoplexy, etc. Among the lesions which have been observed by this instrument, are hyperæmia, more or less opacity and tumefaction of the optic nerve, engorgement of the vessels of the retina, with serous or sero-fibrinous exudation and ecchymotic points. In certain protracted diseases, as chronic hydrocephalus, in which dimness or loss of sight occurs, the ophthalmoscope discloses a state of atrophy of the optic nerve. Heretofore this instrument has been chiefly employed by oculists, but as it comes into more general use, there can be little doubt that it will be recognized as an important aid in the diagnosis of obscure cerebral diseases.

Still, with all possible aids to diagnosis, the obscurity which attends the invasion of many of the cerebro-spinal diseases must be acknowledged. To the hasty and careless physician, their symptoms are often deceptive. Careful weighing of the phenomena, and thorough and protracted examination, are requisite in order to insure correct diagnosis and proper treatment. Some of the cerebro-spinal affections are, in reality, sequelæ of other diseases, as, for example, spurious hydrocephalus; and some are, strictly speaking, only symptoms, as convulsions; but, on account of their importance, and because they require special treatment, it is proper to consider them as diseases *per se*.

The brain presents certain peculiarities in infancy and childhood. In the fœtus, while the other organs are well formed, the brain, especially its cerebral portion, is still diffluent, and at birth it has so little consistence that it must be handled carefully to prevent laceration. This softness is due to the large proportion of water which it contains. The following analyses show the composition of the brain in three periods of life:

	Infant.	Youth.	Adult.
Albumen	7.00	10.20	9.40
Cerebral fats	3.45	5.30	6.10
Phosphorus	0.80	1.65	1.80
Osmazome, salts	5 96	8.59	10.19
Water	82.79	74 26	72.51

At birth the brain has a nearly uniform white color. The gray substance, in which the nervous power originates, is undeveloped. The date of its appearance corresponds with the first exhibition of emotion or intelligence, and the decided gray color which we observe in the brain of the adult does not appear until the age of full mental activity.

In the newborn the brain is large in proportion to the rest of the body, and its growth during infancy and childhood is rapid. Until the fifth year, as appears from the observations of Dr. Peacock, its weight is about one-seventh or one-eighth that of the entire system, the proportions varying somewhat in different cases.

The brain does not attain its full size, as stated by Dr. West, at the age of seven years, but, according to Dr. Peacock's statistics, it con-

tinues to increase till the age of twenty-five or thirty, although its growth is less rapid after the age of seven years than previously.

The membranous covering of the cerebro-spinal axis is scarcely less interesting to the pathologist than the axis itself. I shall speak in the following pages of the arachnoid and cavity of the arachnoid, for convenience of description, although aware of the fact that some eminent authorities, as Virchow and Kölliker, whose opinions in reference to the minute anatomy of the system always command attention, if not assent, believe that there is no arachnoid, but what has heretofore been called by this name is on the one side the smooth surface of the dura mater and on the other of the pia mater.

The dura mater is seldom involved in the diseases of early life, except as it is affected by pressure, while the pia mater and arachnoid are the seat and source of some of the most important diseases, as meningitis, meningeal apoplexy, etc.

The more complicated and delicate the structure of an organ, the more liable it is to errors of nutrition and growth. There is, therefore, no organ which is so liable to irregular development as the brain. It may be entirely wanting; or it may be partially developed, certain portions being absent; or, lastly, its growth may be excessive, constituting hypertrophy.

CHAPTER I.

ACEPHALUS—ANENCEPHALUS.

ENTIRE absence of the encephalon is not common, but there are many cases of this monstrosity on record. In extreme cases the head and part of the neck, as well as the brain and medulla oblongata, are absent. When there is great deficiency there is often a twin, the presence of which has interfered with the full development of the fœtus. Sometimes the growth of other organs besides the brain is imperfect.

ANATOMICAL CHARACTER.—In the ordinary form of anencephalus the brain and sometimes the medulla are absent, with the absence or imperfect development of their membranous and osseous covering. The vault of the cranium is absent. There is deficiency of the frontal, parietal, and occipital bones, except those portions which are near the base of the cranium. These portions are very thick and closely united, as if there were the usual amount of osseous substance, but instead of expanding into the arch, it had collected in an irregular mass at the base of the cranium.

The absence of the brain and the cranial arch gives a remarkable appearance. The eyes are prominent, the neck thick and short, while the body and limbs are ordinarily well developed. The physiognomy has been compared to that of some of the lower animals.

The base of the cranium is often occupied by a vascular tumor, not large, but of different size in different cases, and continuous below with the spinal pia mater. The vascular tumor is the representative of the cranial pia mater, and its smooth surface is the analogue of the arachnoid. The dura mater and the scalp being absent, the exposed mass resembles very much in appearance, as it does in structure, the placenta, and the sensation which it imparts to the finger pressed upon it is very similar. Sometimes small portions of cerebral matter are found among

Fig. 27.

the vessels of this tumor, but they are so disconnected or isolated that they do not perform, in any way, the function of a brain. Occasionally the vascular tumor is absent and the medulla or upper extremity of the spinal cord is exposed, or it terminates in a little papilla at the back of the neck.

Those portions of the cranial nerves which lie external to the cranium are well developed, although the intracranial parts may be absent.

Symptoms.—The respiration in anencephalous monsters is irregular. They can be made to cry, but their cry is a sort of sob or hiccough, and occasionally they even nurse. The digestive function is well performed, and regular urinary and fecal evacuations occur. There is a tendency in anencephalous monsters to convulsions. Blowing upon them, and pressure upon the projecting medulla, if this be present, frequently produce this effect.

Prognosis.—Fortunately these monsters are short-lived. If the medulla oblongata, which is essential to the maintenance of respiration, be absent, extrauterine life is impossible. Stillbirth is the result. If the medulla oblongata be present, although respiration and circulation are established, death commonly takes place within two or three days, and almost always within the first week. Convulsions sooner or later occur, ending in fatal coma.

CHAPTER II.

IMPERFECT BRAIN.

Between the absent and complete brain there are various grades of deficiency. Parts of the brain may be perfect, while other portions are either absent or imperfectly formed. The deficiency is usually in the superior parts of the brain, especially in the hemispheres of the cerebrum, while the base of the organ is perfect. Both hemispheres may be absent, or one may be absent, while the other hemisphere is shrivelled or rudimentary. Occasionally the cranium preserves its normal shape and size, in consequence of an increase in the cerebro-spinal fluid proportionate to the lack of brain-substance. The imperfect development is not then apparent to the observer. The rudimentary hemispheres in these cases are spread out, forming the walls of a sac inclosing the liquid. The post-mortem examination of the following case was made in the Nursery and Child's Hospital, of this city, in 1862.

Case.—Female; parentage healthy; she was plump and well formed at birth, and nothing unusual was observed in her condition, as she nursed and throve like other children, till she reached the age when there is, usually, the first manifestation of intelligence. With her there was no evidence of any intellect, or, if any, it was very indistinct. She nursed, or took food when placed in her mouth, but apparently without relish, as if instinctively. She never reached her hands toward the nurse, or toward playthings. So indifferent and apparently unconscious was she of objects around her, that it was thought for some time that she was blind. She never smiled, except when her hands were gently rubbed or shaken; and then the smile seemed to be a movement more reflex than emotional. The smile was immediately succeeded by a fixed vacant look. She usually lay quietly, with her arms crossed; and during the last month of her life she sometimes uttered a scream, like children with cerebral diseases. Her evacuations were regular, and she was not subject to vomiting, before she was attacked with the acute disease of which she died. The size of her head was rather less than usual at her age, but not less than is often seen in well-formed children. The forehead was small in proportion to the rest of the head, but the difference was not such as to attract attention. Fortunately, the existence of this idiot was terminated by an attack of entero-colitis at the age of about ten months.

Sectio Cadav.—The head was measured, but the measurements were lost. They did not seem to differ materially from the normal standard. The sutures were united, and the fontanelles nearly, if not quite, closed. The frontal bone lay a little lower than the plane of the parietal. The meninges of the brain presented nearly their normal appearance, but were distended with transparent serum. The quantity of fluid was estimated at about two-thirds of a pint, and when it was evacuated the floor of the lateral ventricles was brought into view. There was an almost entire absence of that part of the brain which lies above the floor of the ventricles.

On close inspection, rudimentary cerebral hemispheres were found in a thin layer forming a part of the walls of the sac. The whole amount of brain-substance above the ventricle did not exceed the size of a small egg. The cerebellum, the base of the brain, and cranial nerves presented their usual appearance. The entire brain, after being a few days in diluted alcohol, weighed six and a quarter ounces.

In this case, the fluid was only sufficient to compensate for the deficiency of the brain. In other, and probably the larger number of cases of incomplete brain, the cerebro-spinal fluid is not materially increased. There is then but slight elevation of the frontal bone, the forehead is low, or retreating, or even almost absent. This is that shape of head which is universally regarded as characteristic of idiocy.

Symptoms.—The symptoms in cases of deficient brain relate to the mind. If the cerebral hemispheres are absent, there is no intelligence. The individual, as regards mental endowments, does not rise above the instincts of the lower animals. If the hemispheres are partially developed, there is a degree of intelligence proportionate to the amount of cerebral substance present. If the deficiency be confined to one side, there is no apparent lack of intelligence or mental capacity, since, the brain being a double organ, one side performs the functions of both.

Prognosis.—The prognosis as regards life, in cases of imperfect brain, depends not so much on the amount of deficiency as the exact seat of arrested growth. If only the cerebrum be partially, or even entirely absent, the infant may live and thrive. But if those portions lying at the base of the brain, which control the functions of animal life, are lacking, or are imperfectly formed, life is very uncertain, and probably short.

It is evident that no therapeutic treatment can remedy a congenital deficiency. The services of the physician are not required. The philanthropic and patient teacher may impart a degree of intelligence to the idiotic, and the instruction of these unfortunates has of late years been successful.

Microcephalus—Atrophy of Brain.

An abnormally small brain has usually been attributed to premature closure of the sutures and fontanelles by too rapid ossification. But in certain cases which I have met there was no evidence of exaggerated ossification, and the fault seemed to me to be a deficiency in the growth of the brain, while the ossifying process was not exaggerated or was even less than normal. A normal development of the cranial bones, with but little brain-substance to keep them apart, would necessitate early obliteration of sutures and fontanelles. Thus in August, 1878, an infant was brought into the Bureau for the Relief of the Outdoor Poor, with marked microcephalism. Its age was 19 months, and the bone formation was so slow that only two teeth had appeared; the circumference of its head was 14½ inches; it had had repeated convulsions since the age of five months, and the mother stated that its head had

been round and hard from its birth. In microcephalus, death, sooner or later, is the common result; life ends in convulsions and coma.

Again, the brain of the child, when undergoing development, with the cranial bones sufficiently yielding, may not only cease to grow, but may even diminish in size, in consequence of protracted and exhausting diseases. Diminution in the size of the brain occurs especially after fevers and diarrhœal affections of long standing and attended with much emaciation. The waste of the brain corresponds with the general loss of flesh. If the cranial sutures be not united, the occipital and sometimes the frontal bones are depressed, according to the diminished size of the brain, and are overlaid by the parietal. In foundlings of two or three months, this loss of brain-substance is often very striking. In infants of this class who have died of protracted diarrhœa, it is not unusual to observe the occipital bone not only depressed, but extending one, two, or even three lines underneath the parietal.

If the child with shrunken brain, from protracted and exhausting disease, be old enough to express its thoughts, it often seems foolish, talks but little, and perhaps says the same thing over and over again. In one case in my practice, a little girl, having passed through a long course of typhus, persistently repeated during her convalescence, with a silly smile, the questions addressed to her. This peculiarity continued two or three weeks, although her appetite was good, and her restoration to health rapid. In another case a little boy, during convalescence, was wont to laugh heartily at the appearance of the ordinary articles of furniture in the room. Both showed more impairment of mind during convalescence than in the midst of the fever. The friends of such children are in a state of great anxiety lest their minds be permanently enfeebled, but, as the appetite and strength return, the nutrition of the brain is reëstablished, and the mind regains its former vigor. In cases of wasted brain, with cranial bones united, the deficiency is supplied by serous effusion, which is gradually absorbed as the health of the patient is reëstablished, and the brain enlarges. This effusion occurs not only over the convexity of the brain, but also at its base, and sometimes in the ventricles. Dr. West states that in atrophy of the brain, from protracted disease, its texture is firmer than usual. I have not noticed this in infants, but my attention has not been directed particularly to this point. It is probable that there is some change in the anatomical character of the brain, aside from mere waste.

Partial atrophy of the brain sometimes, also, occurs from primary disease located in this organ; the affected portion wastes, while the rest retains its normal development.

CHAPTER III.

HYPERTROPHY OF BRAIN.

In contrast with atrophy of the brain is the opposite state, or hypertrophy. The size of this organ within the limits of health varies greatly in different individuals, but sometimes there is so great an increase in volume as properly to constitute a disease. Fortunately hypertrophy of brain is rare in America.

Pathological Anatomy.—The excess of growth which characterizes this disease has been ascertained to be confined to the white portion of the brain, and ordinarily to that part contained in the cerebral hemispheres. Hypertrophy of the brain is attended by induration, which exists in different degrees in different cases. It is in some so slight as to be scarcely appreciable; while in others it is apparent at once by pressure with the finger, or incision with the scalpel. Rilliet and Barthez state that the induration in some cases resembles in degree and appearance that produced by the action of alcohol. The white substance of the cerebrum is not only resisting and elastic, but its color is unusually pale; it presents even a brilliant or polished appearance. At the same time the gray substance is more or less faded, and its depth in the convolutions is less than in the normal state of the organ. Rokitansky says: "The cineritious matter is generally of a pale grayish-red color. The medullary is always dazzling white, and remarkably pale and anæmic." An unusual case is related by Burnet, in which the gray substance in the corpora striata retained its usual color, and was indurated like the white substance. In exceptional instances the cerebellum as well as cerebrum undergoes hypertrophy, becoming at the same time more or less indurated. In Burnet's case there was induration of the optic nerves. "The internal structure," he says, "of the optic nerves, especially in their bulbs, had the polish, homogeneous appearance, elasticity, and almost the hardness of cartilage." Rilliet and Barthez state that in two cases the spinal cord presented even more marked induration than the encephalon. Congestion is not a feature of hypertrophy. On the other hand, there is often less vascularity of the brain and its membranes than in the healthy state. If the cranial bones be completely ossified at the time when hypertrophy commences, and firmly united, enlargement of the brain is partially prevented. The convolutions are then thin, much flattened, the sulci more or less effaced, the membranes pale and dry, and the ventricles are small and nearly destitute of serum. At the autopsy of such a case, when the dura mater is incised, the expansion of the brain prevents the proper refitting of the skullcap. Occasionally hypertrophy causes more or less absorption of the cranium, and perhaps the sutures already united are pressed apart.

If hypertrophy commence in young infants with the fontanelles and

sutures still open, they usually remain open, or are a long time in uniting. The interspaces continue, not only in consequence of the growth of the brain, which tends to separate the bones, but also in consequence of feeble ossification. The shape of the head arrests attention. Hypertrophy usually produces most enlargement between and above the ears, while the frontal portion of the head, though somewhat enlarged, is less developed.

The direction of the eyes is not changed, as is common in congenital hydrocephalus.

Rokitansky says (vol. iii. page 285): "With regard to the question to be decided by the theory and microscopic examination, as to the nature of the added material upon which the increase of volume depends, I have formed the following opinion from repeated investigations:

"1. The disease is genuine hypertrophy.

"2. It consists, as such, not in an increase in the number of nerve-tubes in the brain, from new ones being formed, nor in an increase in the dimensions of those which already exist, either as thickening of their sheaths, or as augmentation of their contents, by either of which the nerve-tubes would become more bulky; but,

"3. It is an excessive accumulation of the intervening and connecting nucleated substance."

It is now generally admitted that the views of Rokitansky are correct; that hypertrophy of the brain is due to an augmentation in the amount of connective tissue which lies between and unites the tubules.

Causes.—Hypertrophy of the brain results from an error in the nutritive process which sometimes seems to be associated with the rachitic state, or a condition analogous to rachitis. It is not common, is indeed rare, in this country, and is more common in countries like England, where rachitis is more prevalent than with us. Rilliet and Barthez consider frequent congestions of the brain as a common cause. The hypertrophy is most frequently met in hospitals for children, and among the poor of cities, whose systems are rendered cachectic by residence in damp and dark localities, and by unwholesome diet. In the deep valleys of Switzerland, and in parts of South America and Asia, hypertrophy of the brain is common, under the name cretinism. It is associated with rachitis and stunted growth. The abnormal development which occurs in cretinism begins in infancy or early childhood, and the unfortunate subjects of it are short-lived. Cretinism has been attributed to a residence in localities wet and deprived in great measure of solar light, and to general disregard of the laws of health on the part of those affected as well as their parents.

The observations of different physicians also establish a connection between some cases of hypertrophy and the saturation of the system by lead. In what way lead-poisoning leads to hypertrophy is obscure, but the concurrent testimony of different observers is so strong, that we cannot doubt that it does sometimes have that effect. But in a considerable proportion of cases, as in the one presently to be related, the cause is obscure.

Symptoms.—The symptoms, as is the case with most organic diseases of the brain, vary considerably in different patients. Sometimes there

is, at first, more or less depression or languor. If the child be old enough to speak, he may complain of pain in the abdomen or limbs, evidently neuralgic, or of headache. After a variable time vomiting succeeds, and finally convulsions, affecting the muscles of the face as well as extremities; the convulsions are usually clonic, but sometimes, as regards at least the extremities, of a tonic character. The pupils may be contracted or dilated; there is restlessness alternating with drowsiness, and finally coma succeeds.

Hypertrophy may continue a considerable time before serious symptoms arise; but when once developed, these symptoms ordinarily continue with more or less severity till death. Death commonly results within a week after their commencement, but sometimes not till several weeks have elapsed. When death occurs at an early period in the disease, there is usually firm ossification and union of the cranial bones, and, therefore, but moderate enlargement of the cranium.

If hypertrophy commence at a period not far removed from birth, the bones, of course, yield more readily to the pressure, and acute symptoms do not occur so soon. After a time, however, in all or nearly all cases, convulsions supervene. These indicate the gravity of the disease, and are prognostic of its fatal termination.

In a patient observed by Burnet, violent convulsions, followed by loss of consciousness, marked the commencement of acute symptoms. Five days subsequently, the following symptoms were recorded: mobility of the eyes, without expression; pupils contracted, and directed upward; divergent strabismus of the left eye; the senses in their normal state, with the exception of sight; the limbs move by volition. For a month there was little change. Then occurred drowsiness, and increased prostration, and five weeks later the child succumbed with the symptoms of double pneumonia.

Such is the clinical history of hypertrophy. In cases of firm ossification of the cranial bones, and, therefore, no marked enlargement of the skull, the symptoms are similar to those which occur if the dimensions of the head be increased, but compression and death result sooner.

The following case, in which the sutures were firmly united, I attended in 1864. The head was large, but not so large as to attract attention from its disproportion:

Case.—A boy, aged two years and two months, had, when about one year old, intermittent fever, and since then his countenance was uniformly pallid, and his flesh soft. Weaned at the usual time, he remained well till the 1st of January, 1864. In the beginning of this month he was observed to be feverish for some days, and his appetite poor. His health then gradually improved, and he was thought to be entirely well.

On the 26th of February he was suddenly seized with convulsions, general at first, but most severe and continuing longest on the left side. The convulsions lasted a little more than three hours. He recovered fully his consciousness by the following day, but his appetite remained poor; he was no longer amused by his playthings, and was very fretful. The surface was pallid; bowels constipated; pulse but little, perhaps not at all, accelerated. He continued in this state till the 6th of March, when he had another slight convulsive attack, and from this time he never fully

recovered his consciousness. He was fretful if disturbed, his face generally pallid, while the pulse and respiration were not perceptibly altered.

On the following day, the 7th, the left pupil was somewhat larger than the right, but both were sensitive to light. The difference in size continued till near the close of life. Although vision was imperfect, if not altogether lost, the sense of hearing was not impaired.

When questioned, he uniformly answered, "No," with a drawling voice, evidently not understanding what he said.

As the disease advanced, the respiration became at times sighing; but the rhythm of the pulse was not materially altered. The temperature of the surface was changeable, sometimes cool, sometimes warm, and the congested spots or patches, so common in cerebral affections, were also observed at times on the face, ears, or forehead. Through most of his sickness he took drinks readily, and the urine was freely discharged, probably from the iodide of potassium, which he took in one and a half grain doses every two hours.

He became more and more drowsy, again had slight convulsive movements, and finally died, with much apparent suffering, on the 14th of March. The pulse became more accelerated during the last two or three days. On the day preceding his death, the pupils were contracted, and not affected by light.

Sectio Cadav.—Body somewhat emaciated, and eyes sunken; occipito-frontal circumference of head nineteen and a half inches; distance from one auditory meatus to the other over the vertex, thirteen and a half inches; convolutions over the surface of the brain much flattened and compressed; brain generally deficient in blood; medullary substance firm, and of a pure white color; meninges healthy; no other abnormal appearances were observed; weight of brain forty-two ounces.

Diagnosis.—The diagnosis of hypertrophy is not always easy. The symptoms are, in the main, such as occur in other pathological states, especially congenital hydrocephalus. There is most danger of mistaking the overgrowth for this disease. Hypertrophy has, indeed, often been treated for hydrocephalus. There are, however, certain signs by which we may distinguish one from the other. In the ordinary form of congenital hydrocephalus, even when the amount of liquid is small, the orbital plates of the frontal bones are pressed in such a way that the axis of the eyes is changed so as to have a downward direction. The white of the eye can be seen between the iris and the upper eyelid. This gives a characteristic and striking expression to the face. The exception to this is in those rare cases in which the liquid is external to the brain. In hypertrophy this peculiar change in the axis of the eyes does not occur. Moreover, in hypertrophy there is not that uniform expansion of the head which is observed in hydrocephalus, as has been stated above. There are, commonly, greater enlargement, more prominence of the anterior fontanelle, and wider separation of the cranial bones, in hydrocephalus than in hypertrophy. But since in some cases of hydrocephalus the sutures are united, and the fontanelles closed, and there is no change in the direction of the eyes, the reason of the difficulty in making a positive differential diagnosis between these two diseases in certain instances is apparent.

Hypertrophy with consolidation of the cranial bones, and, therefore,

little enlargement of the head, may be mistaken for meningitis. The history of the case, and the means by which we diagnosticate the latter affection, which will be described in their proper place, will usually enable the physician to make a correct diagnosis.

Prognosis.—In forming an opinion as to the probable termination of the disease, we must have regard to the age and general condition of the child, as well as to the degree of hypertrophy. If the disease commence at an early age, when the cranial bones are not firmly united, it is probable that there will be no compression of the brain, so as to endanger life, for a considerable period. We may then hope by proper measures to remove the constitutional state which gives rise to the hypertrophy, before the enlargement is such as to cause cerebral symptoms. If the bones have already united when the disease commences, even slight hypertrophy will produce symptoms, and a speedily fatal result is inevitable. Evidently, also, a child in a marked degree rachitic or scrofulous is much less likely to recover than one whose general health and constitution are less impaired.

Treatment.—The treatment in hypertrophy should be directed mainly to the constitution. Measures calculated to improve the nutritive process are those most likely to check the abnormal growth of the brain. As the disease is one of perverted nutrition, and usually coexists with a vitiated or impoverished state of the blood, tonic and alterative remedies are required. The syrupus ferri iodidi is, therefore, useful, as it is both tonic and alterative. This may be given in doses of three or four drops to a child one year old, three times daily. Cod-liver oil, with or without the iron, is beneficial in some cases. Another remedy is iodide of potassium in combination with a tonic, as the compound tincture of bark.

℞.—Potass. iodid. . . . . ʒj.
Tinct. cinchon. comp.,
Syr. limon. . . . . āā ʒij.—Misce.
One teaspoonful, three times daily, to a child of three years.

The hygienic treatment is not less important than the medicinal. There is little hope of a favorable issue in any case, unless the regimen be such as will conduce to a more robust and healthy state of system. The diet should be plain and nutritious, the apartments clean and airy, and all undue excitement should be avoided.

CHAPTER IV.

THROMBOSIS IN THE CRANIAL SINUSES (PHLEBITIS).

The formation of fibrinous coagula within a vein or sinus is designated thrombosis (*thrombus*, clot). Coagulation of fibrin in the cranial sinuses occasionally occurs, constituting a very serious pathological state. This may result from local disease in the sinuses or in their vicinity, or

from disease external to the cranium. The immediate cause of thrombosis, whatever its location, is sufficient arrest of the circulation to allow the fibrin to coagulate.

Tubercular and enlarged bronchial glands, compressing more or less the venæ innominata, or the descending vena cava, sometimes give rise to thrombosis in the cranial sinuses, the fibrin coagulating in consequence of retardation in the current of blood. I have known thrombosis, in the same situation, also to result from clonic convulsions, occurring in connection with severe spasmodic cough in pertussis, since both the cough and convulsions retard the flow of blood in the veins and sinuses within the cranium. At the post-mortem examination of at least four such cases I found whitish clots in the lateral sinuses.

Thrombosis, in the cranial sinuses, may also occur from inflammation, either in the walls of the sinuses or immediately exterior to them. This is the disease which writers have designated phlebitis of the cranial sinuses, and for a correct understanding of the morbid anatomy of which the profession are indebted to Virchow.

Anatomical Characters.—If a child die with the cranial sinuses and the veins of the brain and of the meninges in their normal state, the blood in these vessels is found at the autopsy dark but liquid, or there are small, dark, and soft clots in the larger sinuses. If there were congestion, but no coagulation, in these vessels in the last hours of life, the clots are more numerous, larger, and longer, sometimes extending from the sinuses into the larger veins which empty into them, but they are still dark and soft, readily falling to pieces when handled. If, again, there have been that degree of congestion and stasis which has resulted in ante-mortem coagulation, or in thrombosis, the clots are, in part at least, whitish, and of a fibrinous or gelatinous appearance; they were formed while the red corpuscles were still carried along in the circulation.

Most of the clots in thrombosis are free, while others are attached lightly to the internal surface of the sinus; occasionally they are so large as to distend the vessel. They extend also in many cases into the cerebral veins which connect with the sinuses, producing prominence and firmness, so as to resemble (Rilliet and Barthez) an artificial injection. The clots do not present a uniform character. In parts of a sinus they consist of almost pure fibrin, of a yellowish-white color, while in other portions they present a gelatinous appearance from the large number of white corpuscles, while other portions are more or less tinged from the presence of red corpuscles. The central part of the clot, after a time, if the case be sufficiently protracted, softens, and presents a puriform appearance. This substance, which is only disintegrated fibrin, was supposed to be pus, till the microscope revealed its true character. It is obvious that small clots forming within a sinus, and having no attachment to its walls, are liable to be carried by the current of blood into the general circulation, unless there be complete obstruction. Virchow has also shown how a thrombus may extend, by gradual prolongation, nearer and nearer the heart, so that one commencing in a sinus may, after a time, reach into the jugular vein. Different observers, as M. Tonnelé, and also Rilliet and Barthez, have traced the

fibrinous masses as far as the cava. The latter writers relate the case of a girl, four and a half years old, in whom the sinuses on the left side, especially those nearest the petrous portion of the temporal bone, were completely filled with clots of a yellowish-white color, intermixed with central dark spots. Similar coagula were also found in the left jugular vein as far as the brachio-cephalic trunk. Whether the walls of the sinus undergo any change depends on the nature of the disease which causes the thrombosis. If it be phlebitis, the coats are thickened from infiltration and injected, and the internal coat has lost its polish. If it be some obstructive disease in the course of the circulation, or a general cause, the coats of the vessel are unaltered, except that they may be stained by imbibition of the coloring matter of the blood. In an infant who died of this disease in the practice of Dr. West, "the sinuses on the left side were healthy, but the blood was almost entirely coagulated. The posterior half of the longitudinal sinus, the torcular, the left lateral, and the left occipital sinuses, were blocked up with fibrinous coagula, precisely such as one sees in inflamed veins, and the clot extended into the internal jugular vein. The coats of the longitudinal, and of the inner half of the lateral sinus, were much thickened, and their lining membrane had lost its polish, was uneven, and presented a dirty appearance."

The mode in which congestion and coagulation occur within a sinus, in consequence of the pressure of a tumor upon this vessel, or upon a vein into which the blood from this sinus flows, is sufficiently obvious. The mode of the production of thrombosis, as a result of clonic convulsions, or of the spasmodic cough of pertussis, is also apparent. How it results from inflammation of the walls of a sinus, that is, from phlebitis, was not understood till explained by Virchow.

The fibrinous coagula which fill the sinus are not an exudative product, as was formerly supposed. Inflammation (in most cases otitis, with caries of the petrous portion of the temporal bone) approaches a sinus. The inflammatory products pressing against the walls of the sinus diminish its calibre at that point, and hence the retardation of blood and the coagulation. Or the walls of the sinus may be thickened by inflammatory infiltration, or even by the formation of little abscesses within the coats in consequence of the inflammation, so as to produce bulging inward, and the result, as regards the circulation, is the same. Whether, therefore, the inflammation occur without a sinus, or within its walls, thrombosis equally results, provided that the diameter of the vessel is sufficiently narrowed by the presence and pressure of inflammatory products.

There is no exudation on the internal surface of a sinus or vein when inflamed, as there is upon serous surfaces. "On the contrary[1] when the wall is inflamed, the exuded matter (exsudatmasse) passes into the wall, which becomes thicker, cloudy, and subsequently begins to suppurate. Nay, even abscesses may form which cause the wall to bulge on both sides like a variolous pustule, without any coagulation of the blood ensuing in the cavity of the vessel. At other times, certainly, phlebitis, properly so called (and in like manner arteritis and endocar-

[1] Cellular Pathology, translation, p. 236.

ditis), is the cause of thrombosis, in consequence of the formation of inequalities, elevations, depressions, and even ulcerations upon the inner wall which favor the production of the thrombus. Still, whenever phlebitis, in the usual sense of the word, takes place, the alteration in the coat of the vessel is almost always a secondary one, and, indeed, occurs at a comparatively late period."

This view of the pathology of thrombosis comports with facts observed at autopsies, and which cannot be explained according to the old theory of phlebitis, namely, smoothness of the internal surface of the sinus; natural color of this sinus, or simple staining from blood; the non-attachment or slight attachment of the coagula, etc.

CAUSES.—Some of these have been already stated at the commencement of this article. It is evident from what has been said that this disease may be produced by any cause which obstructs the return circulation from the head. I have already alluded to tumors which press upon the sinus, or on the vein below the sinus, as a cause. Among the causes may be mentioned also abdominal tumors, narrowing of the chest from rachitis, or caries of the vertebræ, and, finally, compression of the jugular vein by a peripharyngeal abscess.

Sufficient allusion has already been made to inflammation of the internal ear as a not infrequent cause. Thrombosis is, indeed, one of the dangerous results of chronic otitis. Another cause is a reduced or cachectic state of system, apart from any local or obstructive disease. It is a noteworthy fact that a large proportion of those affected with thrombosis, even when it is immediately due to obstructive disease, are cachectic. The explanation of this fact is not difficult. In reduced states of the system the action of the heart is feeble, and passive congestion of the vessels within the cranium is liable to occur. Passive congestion of the veins and sinuses in protracted diarrhœal maladies, which is described in our remarks upon another disease, is an example in point. In this state of feeble circulation very slight obstructive disease may be sufficient to cause thrombosis.

SYMPTOMS.—The symptoms of this disease are often obscure. All of them may and do occur in other maladies of the encephalon. In cases related by M. Tonnelé, cerebral symptoms were well marked, such as faintness, dilatation of the pupils, strabismus, grinding of the teeth, convulsive movements. There may be an almost total absence of such symptoms as would direct attention to the state of the head. This is due to the sudden occurrence of death after the clots have formed in the sinuses. If the clots are large, death soon results in consequence of congestion of the brain and meninges, which is proportionate to the amount of obstruction. Extravasations of blood and transudation of serum not infrequently accompany the congestion and hasten the result.

Dr. West relates the case of a girl who had a mild attack of scarlet fever at the age of eight months, and did not fully recover her health. She continued restless and feverish, and had two violent convulsions two weeks after the scarlatina. In the following months she had anasarca, and when she was nearly a year old another attack of convulsions occurred. Fluctuation was now observed in the abdomen, and in a few days a sero-purulent fluid began to escape from the umbilicus. When

this discharge had continued eleven days, symptoms of a liquid in the right pleural cavity were suddenly developed. She grew weak and emaciated, and finally was seized with extreme faintness, with which she died in forty-eight hours, at the age of thirteen and a half months.

At the post-mortem examination a large amount of pus was found in the abdominal and right pleural cavities. On the right side of the cranium, the sinuses were filled with coagula, and their coats seemed healthy. The left lateral and occipital sinuses, the torcular and part of the longitudinal sinus, also contained coagula, which extended into the jugular vein. The walls of the longitudinal sinus and the internal part of the lateral sinus were thickened, and their inner surface had lost its polish and was uneven. There was congestion of the brain, with points of extravasated blood. If, as is probable, the convulsions were due to some other cause, the only symptom which was clearly referable to the thrombosis was the sudden faintness. In the four cases of thrombosis occurring in pertussis, already alluded to, in which I was enabled to ascertain by post-mortem examination the presence and extent of the clots, the symptoms, which were apparently due to the thrombosis, were those of cerebral congestion. Among these symptoms, stupor, and finally coma were prominent. The convulsions which occurred in both cases were apparently a cause, and not a result, of the thrombosis.

Diagnosis.—It is evident, from what has been said, that thrombosis of the cranial sinuses can rarely be diagnosticated with certainty. The preëxistence of otitis will sometimes lead us to suspect its presence, especially if the otitis have been accompanied by deep-seated pains. Symptoms of cerebral congestion, serous effusion, or apoplexy, occurring in connection with otitis, protracted convulsions, or glandular or other tumors situated so as to compress the vessels which return blood from the brain, indicate thrombosis.

Prognosis.—The prognosis, in any case, is obviously unfavorable. The cause is, ordinarily, permanent, or not readily removed, so that the clots gradually increase. If the cause be a local obstructive disease, death is almost certain, since, in nearly every instance, the obstruction is of such a nature that it cannot be removed by medical or surgical treatment. It is possible that recovery may take place if the clots are few and small, and the cause of the thrombosis be mainly feebleness of circulation in consequence of a state of debility. We know that clots may liquefy, and their elements reënter the circulation; but such a result of thrombosis in a cranial sinus, if it ever occur, is rare. The thrombus, by its presence, serves as a point of attachment around which more fibrin coagulates, so that the obstruction gradually increases till death occurs.

Treatment.—Thrombosis should be treated by cool applications to the head, in order to diminish the congestion, by stimulants and sustaining measures in case the systolic movement of the heart be feeble. Tonics, vegetable or ferruginous, are indicated if there be a cachectic state.

CHAPTER V.

CONGESTION OF THE BRAIN.

CONGESTION of the brain is not peculiar to infancy and childhood, but is much more common in these periods of life than subsequently. This is due, in a great measure, to the fact that in the young the circulation is more readily disturbed by moral as well as physical causes than in the adult.

Congestion of the brain is occasionally primary; more frequently it occurs as a concomitant or sequel of some other affection. Diseases, whether constitutional or local, which in the adult have no appreciable effect on the vascularity of the brain, often cause in the child a decided increase of blood in this organ.

CAUSES.—Cerebral congestion is of two kinds, active and passive. The former results from a cause which directly affects the brain, and increases the flow of blood toward it, or from a cause operating primarily on the heart, and increasing the frequency and force of its systolic movement; the latter is due to some obstruction in the course of the circulation, or to feeble propelling power on the part of the heart.

Among the causes which most frequently produce ACTIVE congestion of the brain in the child, may be mentioned blows or falls on the head, excessive fatigue or excitement, heat, perhaps sometimes dentition, and also various inflammatory and febrile affections, especially in their first stages.

Cerebral symptoms occurring in the course of an essential fever are no doubt often due, in a great measure, to the irritating effect on the brain of the specific principle, whatever it may be, circulating in the blood. Occurring in inflammatory diseases which are located elsewhere than within the cranium, they are often attributed to functional disturbance of the brain. The brain, it is said, sympathizes with the affected part through the system of nerves which unite them. But observations show that symptoms referable to the brain, arising in the commencement of the essential fevers and of the phlegmasiæ, are in many instances preceded by, and are therefore, doubtless, in greater or less degree dependent on, hyperæmia of this organ.

Difficult as it is to ascertain the state of the brain in many diseases in which it is involved, we may determine whether or not there be congestion in the young child by observing the anterior fontanelle. If it be elevated and tense in an acute disease, hyperæmia is indicated. Now, it is often unusually prominent in fevers and inflammations, especially in their first stages, when cerebral symptoms are present. Its elevation, under such circumstances, is obviously coincident with cerebral congestion.

The acute inflammations which are most likely to be attended by

cerebral congestion are those of the mucous surfaces and pneumonia. Severe coryza, tracheo-bronchitis, entero-colitis, and colitis, commencing suddenly with great febrile excitement, are frequently accompanied in their initial stage by active congestion of the cerebral vessels. Cases like the following, which I find in my note-book, are not infrequent. An infant four months old had been sick about two days with coryza and bronchitis, when I was called to see it; the pulse numbered 156; respiration 64; it nursed, and was somewhat restless; cough frequent and dry; bowels moderately relaxed. The mucous membrane of the fauces was injected, and coarse mucous râles were present in the chest. The anterior fontanelle rose above the level of the cranium, and pulsated forcibly. Soon after convulsions occurred, which were relieved by appropriate measures, and on the following day the fontanelle had subsided. The patient gradually recovered without any untoward symptom.

Cerebral congestion and convulsions often mark the initial stage of active intestinal phlegmasiæ. This is especially true of dysentery. The little patient, perhaps from the very inception of the colitis, is drowsy; its surface hot; pulse full and rapid. There is sudden and momentary starting or twitching of the limbs. The anterior fontanelle, if still open, is elevated, and it is not till the lapse of several hours that the cause of these symptoms is apparent from the occurrence of bloody stools.

The causes of passive congestion of the brain are very different from those of the active form. A common cause is obstruction in a sinus or vein by a fibrinous concretion, or by a tumor or abscess external to it.

I have occasionally met cases in which this form of cerebral congestion appeared to be plainly referable to obstruction to the return of blood from the brain by the pressure of bronchial glands, enlarged by hyperplasia in tubercular disease, these bodies diminishing by external pressure the calibre of the venæ innominatæ or the descending vena cava. Rilliet and Barthez have called attention to such cases in the clinical history of tuberculosis. The following case may be cited as an example; it occurred in the infants' service of Charity Hospital, in this city, in April, 1866.

An infant, about one year old, affected with tuberculosis, both bronchial and pulmonary, was observed, during the ten days preceding its death, to bore the pillow with its head almost constantly, so as to wear the hair from the occiput. This movement of the head was the only prominent cerebral symptom. Nothing abnormal was noticed in the appearance of the eyes, nor was the stomach irritable. A spasmodic cough and progressive emaciation attracted attention, but these were referable to the tubercular disease. At the autopsy we found the cerebral sinuses, veins, and capillaries greatly congested. On tracing the veins which return blood from the brain, an inflamed and enlarged bronchial gland was discovered in the angle formed by the convergence of the right and left venæ innominatæ. This gland, which contained but a single point of cheesy degeneration, had attained such a volume by proliferation of its cells that it pressed upon both vessels, so that it

had obviously retarded the circulation in each, and given rise to cerebral congestion.

Passive congestion often occurs in the infant at birth, either from tediousness of the labor or delay in the expulsion of the body after the birth of the head. If it be simple congestion, and not congestion with hemorrhage, it soon passes off. Passive congestion of the brain also occurs in severe paroxysms of hooping-cough, in which return of blood from this organ is temporarily retarded. All are familiar with the congestion which occurs in parts external to the cranium, from the severity of the cough; producing epistaxis, extravasations under the conjunctiva, etc. The extra-cranial obviously indicates the presence and degree of cerebral congestion.

Those who practise in malarious regions sometimes meet cases of dangerous passive congestion of the brain, the result of malaria, occurring especially in the cold state of intermittent fever. In these cases the surface is pallid, its temperature reduced, and the pulse feeble. The blood, leaving the peripheral vessels, collects in undue quantity in the internal organs, producing congestion of the brain, as well as of the thoracic and abdominal viscera. In the child with malarial disease, in whom there is less vigor of constitution than in the adult, death not infrequently occurs in this passive congestion. Two such cases have occurred in my practice, although in this latitude the malarial maladies are mild in comparison with the type which they present in many parts of the United States.

Symptoms.—The symptoms of active congestion of the brain are stupor, great heat of head, throbbing of carotids, restlessness when aroused, twitching of the limbs, and perhaps convulsions. There is also sometimes intolerance of light, and the anterior fontanelle, if open, pulsates strongly. In PASSIVE congestion many of the symptoms are the same as in the active form. Stupor, twitching of the limbs, and fretfulness or irritability when the patient is disturbed, are common, ordinarily without increase of temperature; the surface may, indeed, be cool, and the face is not flushed, nor the eyes injected. The strong pulsation and elevation of the anterior fontanelle, so conspicuous in active congestion, are—the former always, the latter often—lacking. In both forms there is tendency to constipation.

In many cases the symptoms of congestion of the brain are associated with others which proceed directly from the cause of the congestion, but it is not difficult, unless in exceptional instances, to determine which are due to the congestion, and which to the antecedent and coexisting pathological state.

Anatomical Characters.—In active congestion there is an excess of arterial blood in the brain and its membranes. The arteries, to their minutest branches, are seen to be full, presenting the bright hue of oxygenated blood. In passive congestion the sinuses and veins are distended. The pia mater, choroid plexus, and the vessels of the brain, have a darker appearance than in active congestion. In both forms of congestion, if they continue for a little time, other anatomical changes occur. If there be great distention of the capillaries, these vessels are liable to give way, and we find here and there little patches of extrava-

sated blood. In other cases the over-distention is relieved by the transudation of the serous portion of the blood through the coats of the vessels. The cephalo-rachidian fluid is then found in excess external to the brain and in the ventricles.

Prognosis.—The duration and the result of congestion of the brain depend, in great measure, on the nature of the cause. If the cause be trivial, as mental excitement, fatigue, exposure to heat, there is usually prompt relief if the condition of the patient be understood and properly treated. If the cause be general or constitutional, as one of the essential fevers or hooping-cough, or if it be local, but its seat external to the cranium, the prognosis, so far as the congestion is concerned, is not unfavorable, if there be a timely and judicious use of remedies. The most unfavorable cases are those in which the cause is seated in the encephalon, and those in which there is some obstructive disease in the course of the circulation. Congestion occurring from a structural change within the cranium is, from the nature of the cause, without remedy, and ordinarily fatal. Obstructive diseases of the circulatory system, wherever located, being for the most part permanent, give rise, as a rule, to incurable congestion.

Congestion of the brain, if it be not relieved in a few hours, becomes less and less amenable to treatment. It soon passes beyond the resources of our art, and ends in coma; it is seldom protracted beyond a few days. Extravasations of blood, common in active congestion, and serous effusion, common in the passive form, diminish the chances of a favorable result.

Treatment.—The indication for treatment in *active* congestion is plain. Measures should be employed which produce derivation from the brain. Unless there be an asthenic primary affection, in the course of which the congestion is developed, active purgation is required. A saline purgative is ordinarily preferable. If the stomach be irritable, there is no better purgative than calomel. In all cases of active congestion, whatever the cause, the bowels should be kept open. It is often better not to wait for the tardy action of a cathartic, but to give at once an enema of soap and water or salt and water. External derivative agents are also indicated. A warm mustard foot-bath, sinapisms to the back of the neck or chest, and to the feet, and cold applications to the head, are measures which should never be neglected. In many cases those medicines are useful which reduce the contractile power of the heart, as aconite.

This treatment, if employed early, will relieve the congestion in a large proportion of cases; but if there be no improvement, if the child be robust, and if the primary affection be such as does not contraindicate loss of blood, leeches should be applied to the temples or some part of the head. If after the lapse of some hours cerebral symptoms continue, apoplexy or serous effusion has probably occurred. Congestion is then no longer the prominent lesion, and it is proper to designate the disease by another name.

The treatment appropriate for *passive* congestion is somewhat different; cold applications to the head, and those of a derivative nature to the extremities, are useful. As this form of the disease is not primary,

but is dependent on some antecedent pathological state, it is evident that it can only be treated successfully by removing or obviating the cause so far as possible. But the nature of the various obstructions to the intracranial circulation is such that our ability to accomplish this end is very limited.

If the cause be constitutional, or if it be some disease in the neck or chest, it may sometimes be partially or even wholly removed, but if seated within the cranium it is beyond our control. In general, it may be said that depletion is not required or tolerated in passive congestion, and stimulants are often needed.

CHAPTER VI.

INTRACRANIAL HEMORRHAGE (MENINGEAL HEMORRHAGE. CEREBRAL HEMORRHAGE).

Hemorrhage within the cranium is not very infrequent in infancy and childhood; and there is no part of the encephalon, whether the meninges or brain, in which it does not sometimes occur. If the blood be extravasated upon the surface of the brain or between the meninges, the disease is designated by writers meningeal apoplexy; if in the substance of the brain, cerebral apoplexy. Extravasation may also occur in one of the lateral ventricles. This may, for convenience, be described as a form of meningeal apoplexy.

Causes.—Apoplexy is usually (there is an exception) preceded by congestion. If the congestion increase to a certain degree, the distended capillaries give way and extravasation of blood results. Therefore the causes of congestion which have been enumerated in the preceding article are, in great measure, those of apoplexy. Recent microscopic examinations have demonstrated that the corpuscular elements of the blood may escape from capillaries without rupture. While, therefore, it is probable that intracranial hemorrhage in early life commonly occurs from a rupture, its occasional occurrence through the walls of the capillaries must be admitted.

Intracranial hemorrhage is not infrequent in the newborn. It results in them from tediousness of the birth and severity of the labor-pains. At first there is extreme congestion of the meningeal and cerebral vessels corresponding with that of the scalp and face. This congestion, continuing, soon ends in extravasation of blood. In some of these cases forceps have been used to effect the delivery, but it is doubtful whether the use of instruments materially increases the congestion or the amount of extravasation. Certainly, in a large proportion of intracranial as well as supracranial hemorrhages of the newborn, instruments have not been used. An additional cause of the hemorrhage is, in some instances, the use of ergot, which, by producing strong and continuous pains,

interrupts the placental circulation and increases the congestion of the fœtal veins and capillaries.

In infants a few days old intracranial hemorrhage may result from that rapid and fatal disease, tetanus infantum. The hemorrhage is preceded by intense passive congestion, which the tetanic rigidity and spasms produce by obstructing respiration and circulation. Few cases of tetanus infantum occur without more or less extravasation of blood, either meningeal or cerebral. Another cause of this disease is obstruction in the vessels which return the blood from the brain. The various structural changes which produce this obstruction, in different cases, have been sufficiently described in our remarks on cerebral congestion and thrombosis.

The congestion which precedes hemorrhage, when occurring under the conditions described above, is passive.

Among the causes which produce hemorrhage through the intermediate state of active congestion may be mentioned great mental excitement, of which M. Legendre relates a case, and lengthened exposure to the sun's rays, an example of which Rilliet and Barthez have seen. It is also said that compression of the aorta by an enlarged liver or an abdominal tumor has sometimes produced meningeal or cerebral hemorrhage, by causing an increased afflux of blood to the head. A very important cause to which I have not alluded, is that general state of the circulatory system which is designated by the term purpura hemorrhagica. This sometimes results from the antihygienic conditions in which the child is placed. In other instances it results from some antecedent disease, protracted and debilitating, which has produced a profound alteration in the state of the blood and the vessels. The capillaries become less firm and elastic, and easily give way, so that in such patients ecchymotic points are ordinarily found in different parts of the system. The diseases which occasionally end in this hemorrhagic diathesis are numerous. I have known it to occur after measles, scarlet fever, and smallpox. It is also an occasional sequel of chronic diarrhœa, or intermittent and typhoid fevers, and of rachitis.

Anatomical Characters.—Hemorrhage in or upon the brain, in infancy and childhood, differs in important particulars from that occurring in adult life. In the adult, and more so as life advances, the arteries become less detensible and more brittle, so that when hemorrhage occurs it is usually from one of these vessels. In early life, on the other hand, the blood does not ordinarily escape from an artery, but, as has been stated, from the capillaries. The extravasation is not, therefore, so rapid and violent, and is not attended by such laceration and injury of surrounding parts, in infancy and childhood, as at a subsequent age. In the adult the hemorrhage commonly occurs in the substance of the brain. The flow of blood from the ruptured artery separates the brain-substance, producing a cavity in which a clot forms. This constitutes the usual form of apoplexy in the adult. In the first years of life, on the contrary, the extravasation is commonly from the meninges, and the symptoms to which the effused fluid gives rise are for the most part due to its mechanical effect. Cases of hemorrhage in the substance of the brain constitute a small minority, unless during the

days immediately succeeding birth. In early life, therefore, on account of its greater frequency, meningeal hemorrhage is a disease of more importance than cerebral, and its anatomical character should be carefully studied.

In *meningeal hemorrhage* the extravasation may be between the cranium and dura mater, upon the visceral layer of the arachnoid, in the meshes of the pia mater, or in a lateral ventricle, from rupture of the capillaries in the choroid plexus. Much the most common seat is external to the pia mater in the so-called cavity of the arachnoid; the blood escaping in this situation spreads uniformly in all directions. It soon separates in two portions, the solid and liquid. The solid portion, or the clot, is free or but slightly attached to the adjacent membrane. The meninges in the vicinity of the extravasated blood preserve their normal appearance, or are but slightly injected; the clot gradually becomes extended on all sides, so as to form a lamina at the seat of the extravasation, thinner at its circumference than centre, and at first of a dark red color. The color gradually fades, and the lamina, becoming smooth and polished, and at the same time more and more attenuated, finally resembles the arachnoid in appearance. Its diameter varies in different cases from a few lines to two or three or more inches. M. Tonnelé relates two observations in which the adventitious membrane extended over the superior surface of both hemispheres, and in one of them, also, over the falx cerebri.

The extravasation may occur at any part of the surface of the brain, but its usual seat is the vertex. The next most frequent locality is the base of the brain. The subsequent history of the delicate membrane into which the clot is gradually transformed is interesting. It often extends so as to cover more space than was occupied by the extravasated blood, and its edges are then scarcely distinguishable, in consequence of their extreme tenuity, and their close resemblance to the arachnoid. The attachments of this membrane, so far as it forms any, are usually to the parietal surface of the arachnoid. Sometimes a portion of the membrane is attached, while the rest lies free, bathed on either side by the liquid portion of the blood which still remains from the extravasation. According to M. Legendre, in the most favorable cases, the serum is absorbed, and the membrane which has resulted from the clot, and which I have described, becomes intimately adherent to the internal surface of the dura mater. It forms an integral part of this membrane, and there only remain a little thickening and increased opacity, indicating the seat of the extravasation. The health is fully reëstablished.

But the result in other cases is as follows: The serum is not absorbed, and the newly formed membrane, uniting at points with the inner surface of the dura mater, or its arachnoidal covering, incloses the fluid so as to produce a circumscribed hydrocephalus.

Sometimes there is only one cyst; in other instances the membrane, especially if large, unites in such a way as to give rise to more cysts than one. The size of the cyst varies, according to the quantity of fluid, which may be only a few drachms or several ounces. Rilliet and Barthez report a case in which there was a pint of fluid lying over each

hemisphere, there being two cysts. If the cranial bones are not united, so that they yield to the pressure, the size of the cranium is increased, and if the extravasation be confined to one side, an inequality results, and the symmetry of the head is destroyed. The fluid which causes the enlargement of the head in such cases is in part the serum of the extravasated blood, and in part a subsequent secretion.

Various writers relate cases of ventricular hemorrhage. Valleix met it in an infant that died at the age of two days. In the *Edin. Journ. of Med. and Surg.*, October, 1831, an interesting case is related. A boy nine years old died of hemorrhage in both ventricles, and also at the base of the brain and in the spinal canal. In the Nursery and Child's Hospital of this city, the post-mortem examination was made of an infant who died at the age of one month. In the posterior cornu of the left lateral ventricle were two clots, elongated and black, one larger than the other. In the corresponding cornu, on the opposite side, was a smaller clot. A similar post-mortem appearance was observed at the autopsy of a young infant in the infant service of Charity Hospital. A dark crescentic clot lay in each posterior cornu. The clot, if remaining a long time, undergoes degeneration. In the case of an adult, in which a year had elapsed after the extravasation, I found it to contain crystals of cholesterin and carbonate of lime.

Cerebral Hemorrhage, or hemorrhage in the substance of the brain, may occur at any time in infancy and childhood. The blood is sometimes extravasated in points, here and there, over the entire organ, or a part of the organ; in other cases it is extravasated in one or perhaps two cavities, as in the ordinary form of apoplexy in the adult. In the first form of cerebral hemorrhage, or that in which the blood escapes from numerous points through the brain, there is evidently little laceration or injury of the organ. The brain-substance surrounding the hemorrhagic points sometimes preserves the usual appearance. It is white and firm. In other cases it presents a reddish or yellowish appearance, and is softened to the depth of a line or two. If the hemorrhage occur in a cavity, as in apoplexy of adults, the nerve-fibres are evidently torn and separated, and there is more or less compression of the surrounding brain-substance. Unless the disease be of long standing, the cavity contains a dark and soft clot bathed with serum, which has a reddish or a yellowish-red appearance. The brain in the immediate vicinity of the cavity is sometimes softened. Rilliet and Barthez state that they have seen eight cases of cerebral hemorrhage of the capillary form; ten cases in which the hemorrhage was in cavities; and in two of the eighteen both forms were present. In five of those in which the form was capillary the disease was limited to portions of the brain, while in the remaining three the hemorrhagic points were found in nearly every part of the brain.

Apoplectic cavities are seldom seen in the cerebellum, and, whether the hemorrhage be capillary or in a cavity, there is, in most cases, as previously stated, more or less congestion of the vessels of the brain.

The proportion of cases of cerebral to other forms of hemorrhage is believed by some to be greater in the newborn than at any other period of life. Valleix relates four cases of intracranial hemorrhage occurring

at this age, two of which were cerebral, one ventricular, and in the other the extravasation was in the cavity of the arachnoid. Mignot has published eight cases occurring in the newborn, in two of which the hemorrhage was in cavities in the cerebrum; in three, in the lateral ventricles; and in three, external to the brain. If the same proportion be observed in other statistics, one in three of the cases of intracranial hemorrhage occurring in the newborn is cerebral.

SYMPTOMS.—The symptoms in intracranial hemorrhage are not uniform; they vary according to the seat as well as the quantity of the effused blood. In some cases the extravasation occurs without such symptoms as would direct attention to the brain. When the hemorrhage occurs at the time of birth, in consequence of strong and long-continued labor-pains, the infant is often born apparently dead. This is due partly to the hemorrhage, partly to the great congestion of the brain which precedes and accompanies the hemorrhage. Resuscitation is gradual and difficult. The infant's features are livid, and perhaps swollen; its respiration is gasping, and both pulse and respiration are slow. Its cry is feeble, with but slight movement of the facial muscles, and the lungs are but partially inflated; the eyelids are closed, and the limbs almost motionless. By artificial respiration and by friction, the pulse and breathing may be rendered more frequent, but the latter remains irregular and gasping. Finally, the limbs grow cold, the surface, from a state of lividity, becomes pallid, and death occurs in profound coma. M. Cruveilhier made many observations at the "Maternity" in reference to the death of newborn infants, and he believes that one-third of those who die in birth, at the full period, die of apoplexy. I have made post-mortem examinations in a few cases, when death had occurred from this cause, and in all the hemorrhage was meningeal. One of these was born on the 30th of December, 1864. The birth was delayed by unusual projection of the promontory of the sacrum, so that finally the application of forceps was necessary. The infant was apparently stillborn, but by persistent efforts on the part of the physician who assisted it was resuscitated so as to live several hours, though with constant embarrassment of respiration and with lividity. At the autopsy a large extravasation of blood was found in the cavity of the arachnoid, over a considerable part of the convexity of the brain, and the substance of the brain was deeply congested.

Apoplexy in the newborn does not always terminate fatally, or, when fatal, in the sudden manner which I have described. Valleix relates the case of an infant who died of pneumonia at the age of three and a half months. Its birth had been protracted and difficult, but was completed without the use of instruments. It had had during its entire life paralysis of the right side. At the autopsy a clot was found near the base of the right thalamus opticus, evidently existing from birth. Around the clot the brain was softened to the depth of some lines, and was of a bluish-red color. A very similar case is related by M. Vernois. An infant lived forty-nine days with paralysis of the left side, and died of pneumonia. At the autopsy a hemorrhagic excavation in process of cicatrization was found behind the right corpus striatum and the thalamus opticus.

Intracranial hemorrhage occurring from accidents of birth is generally attended by marked symptoms, such as have been described. But when it occurs subsequently to birth, whether in infancy or childhood, the symptoms vary greatly in different cases, and are generally obscure. I will briefly state the symptoms which have been observed in both the cerebral and meningeal forms of this disease. First, the cerebral. Sédillot relates the case of a child seven and a half years old, whose bare head had been exposed several hours to the sun's rays. Suddenly, after a paroxysm of anger, it was seized with great pain, corresponding with the posterior and inferior fossæ of the cranium. It uttered piercing cries, and died in a quarter of an hour. A clot was found in the right lobe of the cerebellum. Richard Quinn (Rilliet and Barthez) gives the history of a boy nine years old, who in playing with a hoop suddenly stopped, carried his hands to his head, and fell backward unconscious. Three or four hours afterward when examined, he was found pale, surface cool, respiration slow and at times stertorous, pulse 50 to 60 per minute; the left arm was flexed, the left leg paralyzed; the right leg and arm convulsed; right pupil strongly dilated, the left contracted. He died seven hours after the commencement of the attack, and a large clot was found in the centrum ovale on the right side.

Rilliet and Barthez relate the following case from Campbell. A boy with good previous health was suddenly seized about 7 A. M. with repeated vomiting, and in an hour and a half with violent convulsions; he rolled his eyes and uttered inarticulate cries; pulse frequent and hard; pupils contracted; trunk and lower extremities cool. In the afternoon he presented symptoms of compression of the brain, such as dilatation of the pupils, frequent and feeble pulse. Death occurred in the evening, and a hemorrhagic cavity was found occupying the right middle lobe of the cerebrum. Guibert relates a case of extravasation in the superior part of the right hemisphere of the brain in a boy fourteen years old. The principal symptoms were feebleness of the limbs, inability to walk, cephalalgia, involuntary evacuations, fever, grinding of the teeth, rigors severe and prolonged, lividity, loss of intellectual faculties, dilatation of the pupils, insensibility to light, stertorous respiration. Death occurred in about an hour.

Rilliet and Barthez narrate the history of a girl two years old, who, after an attack of measles, was taken with convulsions accompanied with fever and prostration. The convulsive movements affected especially the eyes and upper extremities; the right leg was immovable; the left pupil dilated. These symptoms resulted from hemorrhage in the corpus striatum and opticus thalamus. The same authors relate also the case of a girl, seven years old, who died with a large apoplectic cavity in the left thalamus opticus. The symptoms were headache, convulsive movements, loss of consciousness, delirium, vomiting and constipation, and convergent strabismus. These symptoms nearly disappeared, but in a few days the headache returned, with strabismus and a slight drawing of the face toward the left; on the twenty-seventh day convulsive movements of the right eye were observed, with paralysis of the arm. Finally contraction of the arms occurred, with acceleration

of pulse, irregular breathing, dilated pupils, paralysis, and retraction of the head, followed by death on the forty-eighth day.

These cases, and those from Valleix and Vernois, which have been related in our remarks on hemorrhage of the newborn, are sufficient to show the character of the symptoms in that form of cerebral hemorrhage in which the extravasated blood forms a cavity in the interior of the brain.

If the amount of extravasation be large, and the substance of the brain be much lacerated and compressed, death may occur almost immediately, and, therefore, without symptoms, or before it is possible to determine whether or not symptoms are present. If the disease be not so speedily fatal, the symptoms, as appears from the above cases, are headache, confusion of thought, or even insensibility, cries, sometimes piercing, cold extremities, pallor, slow and perhaps stertorous respiration, convulsive movements followed by paralysis, or convulsions affecting one or more limbs, with paralysis of others, pupils contracted or dilated, sometimes one contracted and the other dilated, strabismus, rolling of eyes, vomiting.

These symptoms have all been observed in different cases, but they are not all present in any one case. Those which are generally present, and on which we mainly rely for diagnosis, are headache, convulsive movements, paralysis, confusion of thought, irregularity in the pupils, and strabismus.

In the CAPILLARY form of cerebral hemorrhage there is usually some complication, so that it is not easy to determine how far symptoms are due to the hemorrhage, and how far to the coexisting pathological state.

There are, indeed, but few published observations of cerebral hemorrhage in the substance of the brain unaccompanied with meningeal hemorrhage, hemorrhage into a ventricle, or some other distinct disease, but so far as I have been able to ascertain the symptoms referable to this form of extravasation, they are as follows: The child is drowsy; fretful when disturbed; it perhaps moans. There are sometimes slight convulsive movements and partial paralysis. If there be considerable extravasation, the respiration is irregular and sighing. Death occurs in coma, occasionally preceded by convulsions. Taupin relates the case of a child nine years old, who died with this form of hemorrhage, accompanied by softening of the brain. The disease began at night, with delirium, agitation, and piercing cries. In the morning the patient lay in bed, drowsy, not complaining of pain, and not replying to questions; pupils dilated, and insensible to light; left eye half open during sleep, and its axis changed; eyebrows contracted; face pale; mouth open; had no convulsions, but transient stiffening of the limbs, during which the thumbs were firmly compressed by the fingers; senses unimpaired, but the face drawn to the right; deglutition difficult; pulse small, irregular, and feeble; respiration 32, sighing. In the evening he had rigidity of the limbs and back, and, finally, was taken with general convulsions, in which he died at eleven o'clock. The hemorrhagic points in this case were numerous. A boy five years old, whose case is described by Rilliet and Barthez, died of this disease, pneumonia, and white softening of the intestine. During the last five days there were

cerebral symptoms, the chief of which were drowsiness, fretfulness when disturbed, and moaning without apparent cause. Another child, whose case is described by Rilliet and Barthez, died at the age of four years, with cerebral capillary hemorrhage, accompanied by yellow softening. Six months before death he had general convulsions, followed by spasmodic movements of the left side. These subsided, but the left side remained feeble.

In Meningeal Hemorrhage there are often convulsions, general or partial, in some patients tonic, in others clonic. When partial, the convulsive movements may only occur in the muscles of the face and eyes. With the spasmodic muscular action is a degree of drowsiness and irritability. Paralysis, so common in the apoplexy of the adult, and not infrequent, as we have seen, in the cerebral form of early life, is sometimes, but not ordinarily, present in meningeal hemorrhage. Instead of paralysis, there are vomiting, some febrile action, thirst, and loss of appetite. The symptoms are different, however, according to the exact seat of the hemorrhagic extravasation, and the duration of the disease. If the extravasation end in the formation of a cyst, the symptoms are those of hydrocephalus. The following condensed history of cases which I have selected as typical, will give us a clearer idea of the history and course of the various forms of meningeal hemorrhage than can be imparted by a narration of symptoms:

M. Tonnelé relates the case of a child who was taken with faintness and convulsive movements. On the following day the trunk and inferior extremities became rigid; deglutition was painful; the pupils were largely dilated, immovable; face pale; pulse feeble and intermittent. Death occurred the same day. The dura mater was distended. A layer of coagulated blood, of great thickness, extended over the convexity of each hemisphere. The veins ramifying in the superior portion of the cerebrum were distended with coagulated blood. The hemorrhage was in the meshes of the pia mater. Drs. Lombard and Panchard, of Geneva, relate a somewhat similar case. A child, thirteen months old, was convalescing from inflammation of the bronchial and intestinal mucous surfaces, when it was seized with general convulsions; the mouth and eyes were open, and the eyes directed upward; pupils contracted; pulse frequent and irregular. The convulsions abated somewhat; but soon reappeared with violence. The patient became insensible, and died nineteen hours after the commencement of cerebral symptoms. The extravasated blood covered the upper surface of both hemispheres. From the above cases we see the symptoms and the course of meningeal hemorrhage, when the extravasation is so large that death speedily results. In protracted cases of meningeal hemorrhage, there is either a gradual disappearance of symptoms and return to health, or, circumscribed hydrocephalus occurring, the symptoms of that disease arise.

Diagnosis.—It is evident, from what has been stated, that the diagnosis of intracranial hemorrhage is attended with unusual difficulty, since the symptoms of this disease occur also in other and distinct pathological states. The history of the case, and especially the character of the cause, if ascertained, will aid in diagnosis. If there have been an obvious determination of blood to the brain, or some known obstruction to

the return of blood from that organ, the persistence of cerebral symptoms would justify us in concluding that either serous or sanguineous effusion had supervened on a state of congestion. The points of differential diagnosis between apoplexy and meningitis are the sudden and full development of symptoms in one case, the gradual commencement and gradual increase of symptoms in the other; differences also of symptoms in certain respects; for example, as regards febrile reaction, constipation, etc.

There is one symptom in cerebral hemorrhage which is of great diagnostic value, namely, paralysis. Its presence affords strong evidence that there is extravasation of blood, and probably in a cavity in the substance of the brain. If the extravasation end in the formation of a cyst, the symptoms and appearance of hydrocephalus, which, after a time, arise, throw light on the nature of the disease.

PROGNOSIS.—There can be no doubt that many cases of intracranial hemorrhage occur and terminate favorably without the nature of the disease being suspected. In such cases the amount of extravasated blood is small or moderate. In several published cases in which the accuracy of the diagnosis was shown by post-mortem examinations, the patients were convalescing from the hemorrhage when they succumbed to intercurrent diseases. If, however, the amount of extravasated blood be such as to give rise to those symptoms which have been described, the prognosis is unfavorable. Recurring convulsions, and persistent stupor from which it is difficult to arouse the patient, are unfavorable symptoms. If the convulsions cease, and consciousness return, even if there be paralysis, the result may be favorable.

TREATMENT.—The proper treatment in intracranial hemorrhage depends on the state of the patient, the time which has elapsed since the extravasation, and the degree of it, as shown by the nature and severity of the symptoms. If, as is often the case, the patient be robust, and be visited soon after the commencement of the attack, cold applications should be made to the head, mustard to the back of the neck and perhaps chest, and derivation should be produced by mustard pediluvia. In many cases, especially in active congestion, it is advisable to apply leeches to the temple, and the bowels should be opened by a stimulating enema. In active congestion, also, prompt purgation by salines or other cathartics is sometimes of great importance. The object of such treatment is to relieve congestion of the cerebral and meningeal vessels, and thereby prevent further extravasation of blood. If the congestion be active, the pulse continue full and frequent, and the face be flushed, it is proper in many cases to control the action of the heart by a sedative. For this purpose the tincture of aconite root may be given in doses of one drop to a child five years old, repeated in three hours if necessary, or veratrum viride may be used. If the stupor or convulsions continue after sufficient time have elapsed for the patient to receive the full benefit of the above remedies, more active counter-irritation is required. Cantharidal collodion should be applied behind each ear. If the hemorrhage occur from passive congestion, or in a cathectic state of system, active depressing remedies should not be employed. External derivatives are of service, as well as cool applications to the head, and

we should attempt, so far as possible, to remove the cause of the congestion and hemorrhage. If it depend on a cachectic state, tonic or other remedies calculated to relieve this state are indicated. The hemorrhage from such a cause is usually in points in the substance of the brain, or in moderate quantity over the surface of this organ, and by a timely use of constitutional remedies possibly we may prevent further extravasation of blood and increase the chance of the patient's recovery.

If a cyst result from the hemorrhagic effusion, the treatment which is proper is that described in the chapter on Acquired Hydrocephalus.

CHAPTER VII.

CONGENITAL HYDROCEPHALUS.

CONGENITAL hydrocephalus consists in an excess of the cerebro-spinal fluid, lying either external to the brain, or more frequently in its interior. It is due to some vice in the development of the brain or its membranes, or to a pathological state occurring in them during intra-uterine life. This disease is ordinarily apparent from the symptoms and appearances at birth, but not always. Occasionally nothing unusual is observed in the shape of the head or aspect of the infant till after the lapse of some weeks, when the characteristic physiognomy begins to appear. In these cases the disease is still congenital, since there is every reason to believe that the abnormal state to which the excessive production of fluid is due existed from birth. In cases of arrested or partial development of the brain, as, for example, when a considerable portion of the hemispheres is absent, there is often an unusually large quantity of fluid which serves as a compensation for the lack of brain. I do not regard such cases as examples of hydrocephalic disease, since the effect of the fluid is not injurious, but rather useful. I restrict the term congenital hydrocephalus to those cases in which the brain is complete, or, if incomplete, the quantity of fluid is more than sufficient to supply the deficiency.

ANATOMICAL CHARACTERS.—According to M. Breschet, the fluid in congenital hydrocephalus may be—1st, between the dura mater and the cranium; 2d, between the dura mater and the parietal arachnoid; 3d, in the cavity of the arachnoid; 4th, in the ventricles; 5th, between the arachnoid and the brain.

In a large majority of hydrocephalic patients the effusion occurs in the ventricles. As the quantity of fluid increases, the pressure from within gradually unfolds the convolutions of the brain, at the same time producing expansion of the cranial arch. When the amount of fluid is considerable, and it becomes so in the course of a few weeks or months,

the hemispheres are spread out in a thin lamina on either side, gradually decreasing in thickness from the base of the cranium to the vertex, where the brain-substance is sometimes so thin as to be scarcely perceptible. Complete absence of brain in this situation, namely, at the vertex, even in extreme cases of expansion and flattening of the hemispheres from the pressure of the liquid, is rare, though the brain-substance at this point is sometimes almost as thin as either of the membranes, so that the wall of the sac is translucent. The membranes which surround the brain do not usually undergo any alteration, except such as arises from the distention. The falx cerebri sometimes disappears, and sometimes the meninges present a whiter hue from maceration than in health. The distention also causes such an expansion of the pia mater that it becomes very thin, and in places scarcely visible, but its presence in every point can be demonstrated.

The accompanying woodcut represents congenital hydrocephalus as it ordinarily occurs. I saw this infant when it was a few days old, and examined it from time to time till its death. The parents are healthy and have other healthy children. This infant when nine days old began

Fig. 28.

to have clonic convulsions of a mild form in the muscles of the face, neck, and limbs, which occurred almost daily till the age of six weeks, and sometimes every five or ten minutes. When the convulsions ceased in the sixth week, the head was observed to enlarge, and its excessive growth continued till death, which occurred at the age of seven months and one week. While the volume of the head progressively increased, the trunk and limbs emaciated. At death the occipito-frontal circumference of the head was nineteen and a half inches; the vertical from auditory meatus to meatus thirteen and a half inches.

The changes which the cranial bones undergo, both in their chemical

character and in their shape, in hydrocephalic patients, if the amount of fluid be considerable, are interesting and remarkable. The base of the cranium undergoes little change, but those portions of the frontal, parietal, and occipital bones which constitute the arch are expanded in all directions, while they become much thinner. There is deficiency of lime in their constitution, so that the organic elements are greatly in excess. This renders them flexible and semi-transparent. Notwithstanding the expansion of the bones, there are usually interspaces between them, of greater or less size, according to the amount of fluid.

The scalp, being stretched by the pressure underneath, becomes tense and thin, and is scantily covered with hair. The veins which ramify in it are unusually prominent and large, and the head is elastic on pressure, from the amount of liquid beneath. In the common form of congenital hydrocephalus, namely, that in which the liquid is in the interior of the brain, the shape of the orbital plates of the frontal bone is often changed, so that the eyeballs have a downward direction. This change in the axis of the eyes occurs at an early period, and it continues through the entire disease, becoming more and more marked as the quantity of liquid increases. If the amount be large, the lower part of the cornea is buried under the under eyelid, while the conjunctiva is visible between the cornea and the upper eyelid. The persistent downward direction of the eyes is characteristic of this disease, and, in connection with enlargement of the head, is an important diagnostic sign. Nevertheless, hydrocephalus even of the ventricular variety, sometimes occurs without change in the direction of the eyes.

If we examine the interior of the cavity after the fluid is evacuated, we will find at its base the parts which lie in the floor of the lateral ventricles, but changed in appearance in consequence of pressure. The cornua are enlarged, and the thalami optici and corpora striata are flattened. In the early stages of the disease, when the amount of fluid is small, there is probably no absorption or destruction of parts in the interior of the brain. The various portions of this organ retain nearly their normal relation to each other. As the quantity of fluid increases, the foramen of Monro, which unites the lateral ventricles, becomes enlarged, the septum lucidum which separates them disappears, and the two ventricles form a common cavity. In most fatal cases we find this single large cavity. The surface which surrounds the cavity occasionally presents a whitish or semi-opaque appearance, which has led to the belief, that at a period antecedent to birth there was subacute inflammation of this surface, and hence the effusion.

The bones of the face are ordinarily less developed than in healthy children of the same age, so that the disproportion between the head and face becomes a marked peculiarity. The shape of the forehead and face is nearly triangular.

The foregoing remarks in reference to the anatomical characters of congenital hydrocephalus refer in the main to cases which have continued for a considerable time, so that their characteristic features are well marked. In very young infants, in whom the disease is still recent, similar anatomical characters are present, but in less degree.

Congenital hydrocephalus is often associated with other vices of con-

formation, especially with spina bifida. The two, when coexisting, are only parts of the same disease; the large quantity of cerebro-spinal fluid preventing the spinal canal from closing during fœtal development.

The fluid in congenital hydrocephalus consists largely of water, in the proportion even of 99 parts in 100. In addition to this element, there are traces of albumen, chloride of sodium, phosphate and carbonate of sodium, and osmazome.

I have had an opportunity to witness only one post-mortem examination in a case of congenital hydrocephalus in which the liquid was exterior to the brain. This case was under observation in the children's service of Charity Hospital, in 1866. Full notes and measurements of the head were taken, which, unfortunately, were mislaid or lost. The infant had congenital syphilis, and had a pallid, strumous appearance. The shape and relative size of the head are seen in the accompanying figure, from a photograph. While the whole head was enlarged, there was a relative excess of development in the part between and above the ears. The axis of the eyes was not at all changed, and the vision was good. The appearance corresponded so closely with descriptions of hypertrophy of the brain that this was supposed to be the anatomical state. Antisyphilitic treatment was employed, and the syphilitic eruptions had nearly disappeared, when diarrhœa supervened, followed by death. At the autopsy a quantity of transparent or light straw-colored liquid, estimated at six or seven ounces, was found exterior to the brain, in the great cavity of the arachnoid, lying mostly over the superior surface of the organ. There was no excess of liquid in the ventricles, and the brain, though of good size, was not abnormally large, nor did it possess the firmness which is present in true hypertrophy.

Fig. 29.

All cases of congenital hydrocephalus may be embraced in two groups, namely, that in which the liquid is in the interior of the brain, and that in which it lies exterior to the organ. Liquid primarily in the arachnoidean cavity permeates the meshes of the pia mater, and lies in part underneath it, or this delicate membrane may be ruptured. Four of the groups, therefore, described by Breschet, may properly be reduced to one, namely, those groups in which the liquid lies under, between, or external to the meninges. It is probable that some of the cases which led to Breschet's classification were examples of acquired circumscribed hydrocephalus, the result of extravasation of blood. In this form of hydrocephalus, as is stated elsewhere, an adventitious membrane forms external to the liquid, becoming in time thin and delicate, and often bearing a close resemblance to the normal membrane (especially the arachnoid), for which it is sometimes mistaken.

Etiology.—The constitutional vice which gives rise to this disease is probably different in different cases. I have been able, I think, to

attribute correctly a considerable proportion of cases which I have observed, to congenital syphilis, but in other instances, from the character of the parents I could not assign this cause.

Symptoms.—If there be a considerable amount of hydrocephalic fluid prior to the birth of the child, so that the head is abnormally large, parturition is seriously interfered with. The scalp and meninges may become ruptured by the severity of the pains, so that the fluid escapes. If this do not occur, the labor is often necessarily instrumental. Whether the liquid be present before birth or accumulate subsequently to it, the tendency is to an increase of the quantity, and a corresponding enlargement of the head.

The digestive function in this disease is at first well performed. The infant nurses readily, and has its evacuations with the regularity of other children. Not many weeks, however, elapse, in the majority of cases, before defective nutrition is apparent.

While the volume of the head increases, other parts are imperfectly nourished and stunted in their growth. Emaciation of the neck, trunk, and limbs is common, associated with progressive feebleness. In the last stages of this disease there is more or less vomiting, with constipation. If there were previously the ability to support the head, it is now lost and the erect position is no longer possible. In marked cases, when there is great disproportion between the head and the rest of the system, there is frequently not even the ability to rotate the head on the pillow. So long as the cranial bones yield readily to the pressure from within, and there is no compression of the brain, the function of this organ is not seriously impaired. The child recognizes its mother or nurse, and it can be amused like other children, though easily fatigued. The state of the senses is different in different cases, and sometimes at different stages of the same case. The sight and hearing in some are perfect, in others impaired; while in others still they are good at first, but gradually become obscured and lost. It is said that the sense of smell may be perverted, so that agreeable odors are unpleasant, and *vice versâ*. Many, reaching the age at which children begin to walk, cannot walk, or, if they do, it is with a tottering, unsteady gait.

When the liquid increases to that extent, and it usually does sooner or later, that the brain begins to be compressed, dangerous cerebral symptoms arise. The child becomes drowsy, and takes less notice of objects. Spasmodic muscular contractions and finally convulsions occur. The pupils act feebly or irregularly by light, or one is more dilated than the other. Strabismus also occurs. As death approaches, eclampsia, partial or general, becomes more frequent, and is succeeded by stupor from which the patient cannot be aroused.

The following case, which I copy from my note-book, is an example of the common form of congenital hydrocephalus. It will give an idea of the ordinary course of this disease, and show the difficulty which we meet with in its treatment. Female, born November 9, 1859, with the aid of forceps. At birth the fontanelles were unusually large, the cranial bones separated, and the aspect in a marked degree hydrocephalic. She nursed at first, but, the mother's milk failing, she was afterward bottle-fed. At the age of four months her head, which had

increased faster than her general growth, measured from one auditory meatus to the other, over the vertex, seventeen inches; the occipito-frontal circumference, twenty-three inches. At this time she manifested considerable intelligence, being able to distinguish her mother from other persons, though the head was so large that it was necessary to support it constantly on a pillow. From the age of four to six months the operation of tapping was performed six times with a small hydrocele trocar, by Prof. Stephen Smith, at a point near the coronal suture, and from one inch to one inch and a half from the sagittal. At each operation an amount of fluid varying from twelve ounces to one pint was removed, and the head then covered with strips of adhesive plaster, so as to form a complete cap. It was necessary, however, within the twelve hours succeeding each operation, to loosen the dressing on account of either the occurrence of convulsions or symptoms premonitory of them. The head, within a week subsequently to each operation, regained its former size, and, as there was no permanent benefit, this treatment was discontinued. She finally died of entero-colitis at the age of ten months and five days.

At the autopsy the distance from one auditory meatus to the other was twenty and a quarter inches; the occipito-frontal circumference, twenty-six and a quarter inches. The anterior fontanelle measured antero-posteriorly four and three-fourths inches; transversely, seven and three-fourths inches. The parietal bones were separated from each other to the distance of two or three inches, and they measured in length nine and one-half inches.

On opening the cranial cavity, seven pints, by measurement, of transparent fluid escaped, exposing a vast open space, at the bottom of which were the parts which constitute the floor of the ventricles, somewhat changed in shape, and from them, on either side, the hemisphere was spread in a lamina, so as to cover the internal surface of the cranial bones. The laminæ near the base of the brain measured in thickness from half an inch to one inch, and they gradually became thinner on approaching the vertex, at which point the brain-substance was exceedingly thin, so as to be scarcely demonstrable.

The brain had its normal vascularity and consistence, and the cerebellum, medulla oblongata, the base of the brain, and cranial nerves presented their usual appearance. On folding the brain together, it had the size, shape, and aspect of this organ in its ordinary development. Nothing unusual was observed in the membranes except their great expansion. The above case corresponds in its general features with most cases met in practice.

Diagnosis.—The ordinary form of congenital hydrocephalus, that in which the liquid occupies the interior of the brain, can, in most cases, be readily diagnosticated. If there be only a moderate amount of liquid, it may be confounded with hypertrophy of the brain. In hydrocephalus there are commonly more rapid growth and greater expansion of the head; moreover, the enlargement occurs equally on all sides, while in hypertrophy, though all parts of the cranial vaults are expanded, the enlargement is more at the vertex than elsewhere. The hydrocephalic head yields more readily to pressure than the hypertro-

phied, and often communicates a fluctuating sensation. Moreover, in the ordinary form of hydrocephalus, the change in the axis of the eyes described above is an important diagnostic sign. In rachitis the volume of the head is often considerably enlarged, due sometimes, in part at least, to a deposit of calcareous matter on the exterior of the cranial bones. The differential diagnosis is based on the shape of the head, round in one, square or with prominences in the other, on palpation, direction of the eyes, etc. The smaller the amount of liquid, the greater the liability to error of diagnosis; but if the amount be inconsiderable and not increasing, little treatment is required, except hygienic and tonic, which is also proper in both hypertrophy and rachitis. If the liquid be exterior to the brain, as in the case represented on page 445, diagnosis may be difficult, but such cases are infrequent.

Prognosis.—In the majority of cases this is unfavorable, since the secretion of liquid usually continues. The most favorable result is no increase, or but slight, in the quantity, while the natural growth of the infant increases, and thus the disproportion between the head and the rest of the system gradually disappears. Such patients may live to maturity, and have tolerable health, and they may engage in occupations. But ordinarily in cases left to themselves, and even in a large proportion of those having the best treatment, while the quantity of fluid increases, the nutrition of the body and limbs becomes more and more deficient, and the patient, if not cut off by an intercurrent disease, finally succumbs with cerebral symptoms produced by pressure of the liquid. Probably more than half of the hydrocephalic patients die before the close of the second year.

Treatment.—We may attempt to diminish the quantity of fluid by the use of diuretics. Digitalis, squills, nitrate and acetate of potassium, have been used. The most efficient diuretic in these cases, however, is the iodide of potassium. This may be given in doses of one to two grains every two hours to an infant of three months. Constipation, if present, should be relieved by an occasional purgative. If it be tolerated, we may partially prevent the expansion of the head by a close-fitting cap. For this purpose strips of adhesive plaster about one-third of an inch in width, should be applied so as to cover the entire head. The proper way of applying these is as follows: First, one strip from each mastoid process to the outer part of the orbit on the opposite side; secondly, from the back of the neck, along the longitudinal sinus, to the root of the nose; thirdly, over the whole head, so that the different strips will cross each other at the vertex; and, lastly, a strip long enough to pass three times around the head should be applied, passing above the eyebrows, the ears, and below the occipital protuberance. Too tight an application should be avoided, as it may give rise to convulsions or other cerebral symptoms. If the cap can be tolerated, and the general health be good, the prospect is more favorable; but usually, from the increase in the quantity of fluid, it is necessary in a few days to remove or loosen the strips in order to prevent convulsions, or, which is preferable, to diminish the size of the head and relieve the pressure by tapping. In 56 cases collected by Dr. West in which tapping was employed, four recovered. The operation is simple, easily performed, devoid of danger,

and it frequently gives temporary relief. It should therefore be recommended to the parents, even if it do not effect a cure. It should be performed by a very small trocar, which should be introduced in the coronal suture, about an inch external to the anterior fontanelle. A few ounces should be removed, and strips of adhesive plaster or an elastic skull cap applied. In a few days the operation should be repeated as the liquid increases. It is important to maintain compression of the skull before and after the operation (Treves). Sometimes a dozen or more tappings are required at intervals of a few days or weeks, when the secretion may come to a standstill. In the *Med. Chir. Trans.*, 1864, a case is related in which two tappings effected a cure, but so good a result is exceptional. Iodine injections in connection with tapping have so far not produced any satisfactory result. Sir James Paget[1] relates a case in which he injected ten grains of iodine and twenty grains of iodide of potassium in one ounce of water, but the child died of convulsions after the second injection. No appreciable good result has followed the use of irritating or sorbefacient applications to the head. Nutritious diet and attention to the general health are requisite.

CHAPTER VIII.

ACQUIRED HYDROCEPHALUS.

HYDROCEPHALUS, or dropsy of the brain, may also occur in those who at birth are well formed and free from disease. Pathologists call this acquired hydrocephalus. It is in nearly all cases the result of disease, which is located sometimes within the cranium, but often in other parts of the system.

CAUSES.—The diseases within the cranium which most frequently produce serous effusion are the meningeal inflammations, both simple and tubercular, tumors or other causes which obstruct the venous circulation, and hemorrhagic effusion ending in the formation of cysts. Prolonged passive congestion often ends in transudation of serum through the coats of the capillaries. Therefore, all those causes of congestion, except such as have a transient or momentary effect, may be regarded as causes of serous effusion.

Among the diseases external to the cranium which produce serous effusion within or upon the brain, may be mentioned retropharyngeal abscess, tuberculization or inflammation of the bronchial glands, scarlet fever, and certain affections of an exhausting nature, especially protracted diarrhœal maladies. In at least five cases which have fallen under my notice, and in which post-mortem examinations were made, the cause was enlarged tubercular bronchial glands, which, by pressure

[1] Medical Times and Gazette, 1860.

on the venæ innominatæ, so retarded the flow of blood from the brain as to cause congestion and effusion. The causative relation of these glands to cerebral congestion is more fully described in our remarks in reference to this disease.

Dropsy of the brain is common in protracted infantile diarrhœa, as, for example, in advanced cases of intestinal catarrh of the summer months in the cities. It is preceded and accompanied by passive congestion of the cerebral veins and sinuses, due in part to feebleness of circulation in consequence of the exhausted state of the patient, and in part to wasting of the brain, which always give rise to more or less passive congestion, unless in young infants, in whom the cranial bones become depressed and override each other. Dropsy of the brain, resulting from scarlet fever, and that peculiar circumscribed dropsy which results from hemorrhagic effusions, are described elsewhere.

A few cases have been related by different observers, Abercrombie among others, in which dropsy of the brain seemed to be essential. Nothing abnormal was observed, with the exception of serous effusion. But the reports of such cases are, for the most part, meagre; and, as Barrier has well said, we are not to accept such cases as examples of essential dropsy of the brain, unless the post-mortem inspection be so complete as to render it certain that there was no pathological state which might cause the dropsy.

Anatomical Characters.—Acquired hydrocephalus usually occurs after the cranial bones are firmly united, and, therefore, the shape of the head is not materially altered. If it occur at any early age, before there is free union, there may be expansion of the cranial arch, as we sometimes observe in the circumscribed hydrocephalus resulting from hemorrhage. The effusion in acquired hydrocephalus occurs over the surface of the brain, in the subarachnoid space, or in the lateral ventricles. In the dropsy of protracted diarrhœal maladies, I have rarely failed to find the liquid over the whole superior surface of the brain as well as at its base.

The quantity of fluid in this disease is not large. In the majority of cases it does not exceed four ounces, and is often much less. It is transparent, or it has a slightly yellowish tinge. The membranes of the brain sometimes present their normal appearance, but in other cases they are injected. The brain itself, in some instances, has an injected appearance from passive congestion of the veins and capillaries; but in others, when there has been more or less compression of the brain, there is no more than the ordinary, or even less than the ordinary vascularity, and the convolutions are somewhat flattened.

Symptoms.—The symptoms of the pathological state which gives rise to the dropsy, precede and accompany those which are referable to the dropsy itself. The dropsy declares itself by symptoms which are alarming from the first.

In children old enough to speak, or manifest intelligence, there may be at first complaint of headache. The child is irritable, its mind confused or wandering at times, or there is actual delirium. After a time drowsiness occurs. The head seems too heavy for the body, and is buried in the pillow. In fatal cases the features become pallid, the pupils

sluggish, and perception and consciousness are gradually lost. The child lies in profound sleep, which increases. There are now often convulsive movements partial or general, and these soon end in coma, in which the patient dies.

The following was an interesting case of acquired hydrocephalus, which seemed to result from subacute meningitis. The patient was seen by several physicians, and the diagnosis was for a long time doubtful.

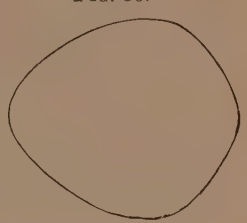
Harry R. L., of healthy parentage, was well till the summer of 1876, when he was nearly at the close of his third year. At this time he was observed to be feverish and fretful and his features were flushed at times. He also complained almost daily of pain in the top of his head, which pain was intermittent, and these attacks of headache occurred for at least six months, perhaps longer. There had been no backwardness in dentition, and no symptoms of rachitis or struma, and his nutrition was good even after the commencement of the present malady.

In February or March, 1877, his stomach became irritable, so that he vomited often during the following months, and about the same time he began to lose the use of both legs—a progressive paralysis—and his bowels became constipated. Both urination and defecation were sluggishly performed.

In July, 1877, he ceased to walk, and he has not been able to stand since.

On March 29, 1878, the following records were made: No improvement, but gradual increase of most of the symptoms; lies constantly; moves his limbs slowly, and infrequently, but completely, and sensation appears to remain in all of them; his eyes are clear and pupils moderately dilated, but without vision—how long his sight is lost is not known; axis of eyes not depressed or otherwise changed, and parallelism retained; the cranium, which during the first year of his sickness underwent little change, has expanded rapidly during the last six months; the enlargement is most marked above the ears; the occipito-frontal circumference is represented in the accompanying diagram; this circumference measures twenty-one and a half inches, of which nine and three-quarters are in front of ears, and eleven and one-third inches posterior to ears; distance over vertex from one auditory meatus to the other, fifteen and one-quarter inches. The anterior fontanelle is observed to be open, though small, the diameter being about one-fourth or one-third of an inch; it is not elevated, and the surrounding edge of bone is flexible.

Fig. 30.



This patient lived till near the close of 1880, without material change in symptoms, and with moderate but progressive increase in the size of the head. At the autopsy measurements were again made, but they have been mislaid. The enlargement was found to be due to the presence of about three pints of straw-colored serum in the lateral ventricles, which had been changed into a large cavity. There was nothing to indicate any other disease. From the history and appearances we inferred that the hydrocephalus had been due to a mild meningitis occurring

in the third year. The appearance and state of the encephalon were precisely like those in ordinary congenital hydrocephalus.

Prognosis.—Acquired hydrocephalus commonly ends unfavorably. The prognosis depends not only on the quantity of liquid, but on the nature of the cause. If the cause be venous obstruction within the cranium or thorax, as we have no means of removing it, death is inevitable. If it be an exhausting disease, as entero-colitis or scarlet fever, although the case is not absolutely hopeless, the prospect is still unfavorable. It is only favorable when the quantity of effused fluid is small, the system not much reduced, and the primary disease mild. When acquired hydrocephalus arises from meningeal apoplexy, the case is usually chronic. The symptoms and termination of this form of the disease are very similar to those in congenital hydrocephalus.

Treatment.—The treatment in acquired hydrocephalus must vary somewhat in different cases, according to the nature of the disease on which it depends. I shall indicate the treatment, in part at least, in the description of these diseases. Occasionally the condition of the patient is such that there is little to encourage us in the employment of any remedial measures. In vigorous children, if acquired hydrocephalus occur in connection with symptoms which indicate too active a circulation, moderate abstraction of blood from the temples at an early period may be useful, but cases requiring such depletory measures are rare. These cases require cold applications to the head; the bowels should be opened, and derivatives should be applied to the feet and back of the neck.

If the congestion be of a passive character, as when the circulation is obstructed by tumors or otherwise, benefit may still be derived from cold applications to the head, and derivatives to other parts. In most cases of suspected dropsy of the brain, unless the patient be in such a hopeless state that all treatment is obviously futile, vesication should be produced behind the ears. I prefer cantharidal collodion for this purpose. In addition to this treatment, diuretics should be employed, unless there be too great prostration, or the course of the disease be so rapid that no benefit can result in consequence of the tardy action of these agents. The best diuretics are the acetate of potassium and iodide of potassium.

CHAPTER IX.

MENINGITIS, TUBERCULAR AND NON-TUBERCULAR.

The most interesting and important disease of the cerebro-spinal system in early life, is that which is now designated meningitis. It is not infrequent. The mortuary statistics of this city show that it is the cause of death in from one in twenty-five to one in fifty of the entire number of deaths, the proportion varying somewhat in different years.

In 1768, the attention of the profession was particularly called to this disease by Dr. Whytt, of Edinburgh. This observer, and the pathologists succeeding him, forming their opinion of meningitis from its most prominent anatomical character, namely, serous effusion, believed it a dropsy. They accordingly designated it acute hydrocephalus. During the last forty years the profession have come to regard the disease as inflammatory, and hence the name by which it is now known, and which is believed to express its true pathological character.

Sometimes meningeal inflammation in children occurs without tubercles. In other instances it results from the presence of tubercles, and in most, if not in all such patients, there are tubercles in or under the meninges, which excite the inflammation in the same manner as in the lungs they cause pneumonitis or pleuritis. Therefore two forms of meningitis are recognized, namely, tubercular and non-tubercular.

Prior to 1868 I had preserved records of forty-five fatal cases of meningitis, some occurring in my private practice, and the remainder in institutions of this city with which I have been connected. Post-mortem examinations were made and recorded in thirteen of them. Twenty-five were under the age of one year, of which fifteen were apparently well when the meningitis commenced, belonging for the most part to healthy families; three were feeble and cachectic, but apparently without tubercles; and five had miliary tubercles in various organs, as shown by post-mortem examination. The condition of the other two as regards the probable presence of tubercles, was not recorded.

Of the twenty who were over the age of one year, the majority, namely, thirteen, presented a decidedly cachectic or strumous aspect before the meningitis occurred, and a considerable number had symptoms of pulmonary tubercles. These statistics, as far as they go, show that non-tubercular meningitis predominates under the age of one year, and I may add eighteen months, while over that age the tubercular cases are in excess.

M. Bouchut, speaking in reference to tubercular meningitis, says as follows: "Up to this period it was not believed that this disease existed in young children, for no mention is made of it in the works of Denis and Billard. Still its existence at this age is, nevertheless, incontestable. MM. de Blache, Guersant, Rilliet and Barthez, and Barrier have observed several examples of it, and I have collected six cases of this disease in the practice of M. Trousseau. The youngest child was only three months old, and the eldest had arrived at the end of his second year. No statistics can be based on so small a number of facts; the only value they have consists in their overruling an opinion falsely accredited in medical science." I have witnessed the post-mortem of five cases of tubercular meningitis occurring in children under the age of one year, as is seen from the above statistics, and the age of one of these was only four months. In two, perhaps I should say three, of the five the presence of tubercles in the meninges was not positively demonstrated; but in all of the five cases miliary tubercles were present in the lungs and other organs, so that I did not hesitate to consider the meningeal inflammation of a tubercular character.

In patients over the age of eighteen months, although the proportion

of tubercular to non-tubercular cases is larger than under this age, the excess is not so great, according to my statistics, as the remarks of some observers lead us to suppose. There can be no accurate statistics of tubercular meningitis without careful post-mortem examination of the state of the brain and other organs in each supposed case, and this examination sometimes shows the meningitis to be non-tubercular, when the symptoms and signs had indicated its tubercular character. As an example, may be mentioned a case which occurred in the children's service of Charity Hospital, in March, 1868. The infant died at the age of twenty months, having had a cough of moderate severity at least three weeks before death, and symptoms of meningitis about four days. It was considerably wasted, and was supposed to have tuberculosis. At the autopsy, no tubercles were found in any part of the body, but portions of both lungs were hepatized. A fibrinous deposit, varying in thickness, was found over the pons Varolii, the optic commissure, along the fissures of Sylvius, over the superior surface of the anterior half and also upon the superior lobe of each cerebral hemisphere. As the examination failed to discover any tubercles, the meningitis was considered non-tubercular. Those who make these examinations, failing to find tubercles in the lungs and other organs in which they usually occur, should examine the lymphatic glands, since cheesy glands may be the cause of the formation of tubercles in the meninges, while the organs of the trunk remain unaffected. The presence of cheesy glands in the absence of visceral tubercles, and with granulations upon the meninges, small, covered with fibrin, and of a doubtful character, goes far toward establishing the tubercular nature of the meningitis. Since the cases which furnished the above statistics were observed, now more than thirteen years, I have been led by a more extended experience, and especially by the observation of cases in the New York Foundling Asylum, where there is ample material, to regard not only the presence or absence of tubercles, but also of caseous substance, as the proper test of the form of meningitis. Not a few that seem at first to have non-tubercular meningitis will be found, on more thorough examination, to have caseous substance in some part, the result of a preëxisting inflammation; and if we regard the inflammation of the meninges occurring under such circumstances as tubercular, the relative proportion of tubercular cases will be considerably augmented. The following is an example. When on duty in the asylum in August, 1881, an infant about one year old died of meningitis. No tubercles were observed in the fibrin at the base of the brain, and along the fissures of Sylvius but one inflammatory nodule (cerebritis) as large as a chestnut, with suppuration inside, was found at the summit of one hemisphere. No tubercles could be detected in any of the organs of the trunk, unless a few whitish spots in the spleen were of this nature, but the bronchial glands were cheesy and softened, and the middle lobe of the right lung also contained cheesy substance. It seemed to me probable that some of this degenerated product taken up by the vessels had lodged in the meninges and produced the tubercular neoplasm there, which was hidden under the fibrin. (See article Tuberculosis.)

Age.—The following table gives the age in meningitis, tubercular and non-tubercular, in forty-two cases in my collection:

Cases.	Age.
1	2½ weeks. (Autopsy.)
2	2 months.
20	From 3 to 12 months.
10	From 1 years to 2 years.
5	From 2 years to 5 years.
4	Over 5 years.
42	

Rilliet and Barthez have also published statistics of the age in meningitis. Their cases were observed chiefly in hospital practice, and the result is somewhat different.

In thirty-two cases of non-tubercular meningitis observed by these authors, eight were under the age of one year, six from two years to five, and eighteen over the age of five years. In ninety-eight cases of tubercular meningitis, two were under the age of one year, fifty-one between the ages of one year and five, thirty-eight between the ages of five years and ten, and seven between ten and fifteen years.

Pathological Anatomy.—This differs considerably in different cases. The dura mater is usually unaffected or is affected secondarily. In many cases it retains its normal appearance, its internal surface remaining smooth and polished, while in others it is more or less injected, and its internal surface dim or lustreless. The free surface of the pia mater, formerly designated the visceral arachnoid, is in a great part of its extent unchanged, but is often hyperæmic, or dry and cloudy, or opaque, over the seat of the inflammation. Exudation does not occur upon the free surface of the pia mater, however intense the inflammation.

In meningitis, tubercular and non-tubercular, the inflammatory action occurs in the pia mater. In its meshes, or underneath them, those lesions result which characterize the disease, and to which other lesions are secondary. Tubercular meningitis is most frequently basilar, or is basilar chiefly and primarily, although the inflammation may extend along the sides of the hemispheres. The meningitis is ordinarily most intense around the pons Varolii in the subarachnoid space and along the fissures of Sylvius, for the tubercular neoplasm occurs chiefly at the base of the brain and along the vessels. In non-tubercular meningitis, the inflammation may also occur at the base. It may in young infants be quite diffuse, and of little intensity in any one place, producing, in addition to hyperæmia of the pia mater, slight cloudiness and a moderate or slight escape of leucocytes from the blood, these (pus-cells) being perhaps visible only under the microscope. In meningitis due to extension of inflammation from an otitis media, the inflammatory action is intense, confined to the portion of the meninges nearest the ear, and is often attended by inflammation of the adjoining brain-substance, with perhaps the formation of an abscess. If the cause be exposure to the sun's rays, the meningitis is at the summit of the brain.

The exudation of fibrin is greatest along the course of the vessels, and in the depressions between the convolutions, and the opacity is most marked in these situations. Pus, when present, is often semi-solid, from the small proportion of liquor puris which it contains, even in recent cases. If the disease have continued several days, the liquor puris may be mostly absorbed, and the pus-cell becoming shrivelled,

irregular, and aggregated, may resemble closely the cheesy transformation of tubercle-cells.

The fibrinous exudation presents features of interest. It does not usually attain much thickness, but by its opacity it conceals from view the brain underneath. If it occur in the fissures of Sylvius, the anterior and middle lobes are united by it. It is usually infiltrated through the substance of the pia mater. Sometimes little masses of variable size, often not as large as a pin's head, appear at the point of inflammation. These masses are firm, of a whitish color, or a light yellow, and their number varies in different cases. They consist of a firm, homogeneous substance, containing granular matter, and cells which often bear a close resemblance to tubercle-corpuscle, but are distinct. These corpuscular bodies are plastic nuclei or plastic cells, often shrunken. It is seen, then, that there are two morbid products which may be mistaken for tubercle: one, pus which has been in great measure deprived of its liquid element, and which may resemble cheesy tubercular matter; the other, plastic nuclei collected in little bodies, so as to resemble the ordinary form of crude tubercle. I once carried to one of the best microscopists and pathologists of this city some of the exudation from a case of meningitis, the cellular element in which could not readily be distinguished from shrunken tubercle-corpuscles. The exudation was from a child two years and eight months old, with good health previously to the meningitis; without tubercles in any part of the body, with parents healthy, and with no predisposition to tubercular disease. The microscopist, not knowing the history of the case, or character of the family, and ignorant, like all of us at that time, of the true tubercle cell, pronounced the exudation tubercular after a careful examination with the microscope. Bouchut says: "The whitish miliary granulations which are observed on the surface of the pia mater have a certain consistency and tenacity which render them difficult to tear with the needles used for the preparation for the microscope. These bodies are formed: 1. Of fibro-plastic elements, whether nuclei or fusiform fibres; oval-shaped cells are generally present, but not always. The nuclei are oval or spherical, generally very small—that is to say, they hardly exceed in diameter 0.008 mm. to 0.009 mm. The presence of these little spherical nuclei must be insisted on, because, with a less power than 550 diameters, it would be sometimes impossible to establish the differences which separate them from the elements of tubercles; the fusiform fibres are small and rare. 2. There exists a considerable quantity of amorphous homogeneous matter, in which minute granulations are scattered; it is very dense, and keeps the other elements strongly united together, so that it is difficult to isolate them completely. 3. Vessels are very rarely observed; the fibres of cellular tissue are also rare, or altogether wanting."

There being two microscopic elements which are distinct from tubercular formations, but are liable to be mistaken for them, namely, shrivelled pus-cells and plastic nuclei, more or less altered, it is seen, in part at least, why the old writers, and some of a more recent date, either hold that all meningitis is tubercular, or that there are comparatively few non-tubercular cases.

On the other hand, there are cases of true tubercular meningitis

which, even with a pretty careful microscopic examination, might be, and probably often have been, regarded as non-tubercular. In order to an understanding of this subject, I may be permitted to repeat certain facts already stated in the article on tuberculosis. The views of pathologists in reference to what is the primary form of tubercle, and what is and what is not tubercular matter, have recently undergone a great change. It is now known that the tubercle-cell is a round, pale, slightly granular cell, identical in appearance with the normal cell of the lymphatic glands, being on the average somewhat smaller than the white corpuscle of the blood; that it is produced mainly from the nuclei of the connective tissue by proliferation; that it is vitalized like other cells, and, of course, has functional activity; that the true, the living cell, is found only in the so-called gray, semi-transparent tubercle. It is furthermore known that what has heretofore been considered the tubercle-cell, namely, the irregular, sometimes angular, sometimes oval cell—without, indeed, any typical form—may be a dead, shrivelled, and altered tubercle-cell, or a dead, shrivelled, and altered pus or other cell. If, therefore, such cells are found in the meshes of the pia mater, we cannot determine from the microscope their true character. We can only form our opinion in reference to their nature from concomitant circumstances, or from discovering in connection with them the true tubercle-cell. Those products which have been designated crude tubercle and tubercular infiltration, contain these shrivelled cells, or shrivelled nuclei; and they may have a tubercular origin, or, on the other hand, an inflammatory origin, without either the tubercular product or diathesis.

In the tuberculosis of young children I have found in a large proportion of cases in which I have had an opportunity to make post-mortem examinations, miliary tubercles disseminated through the lungs, and perhaps other organs, in small masses, many of them not larger than a pin's head, and some occurring as mere specks scarcely visible. These minute tubercular formations have ordinarily been semi-transparent, and sometimes even transparent like minute drops of water, and containing the true and unchanged tubercle-cell. Now if in such a case meningitis occur, we may find the tubercle-cell in or with the fibrin at the base of the brain. But failure to find it, even with protracted microscopic examination, does not prove its absence from this locality, for I consider it almost impossible to discover in the midst of the fibrinous exudation such minute points of tubercular matter as are seen in the lungs, liver, or elsewhere.

The pia mater is often firmly adherent to the brain at the seat of inflammation, so that on raising it a portion of the brain may be detached and removed with it. The extent of the inflammation varies much in different cases. There may in extreme cases be pretty general inflammation of the pia mater. In cases of such extensive meningitis, the symptoms are usually severe and the course of the disease rapid. Thus, in the month of April, 1866, a girl eleven years of age, in the Protestant Episcopal Orphan Asylum of this city, had complained occasionally of dizziness, but was otherwise in good health, cheerful, and with excellent appetite, till Thursday, when she was affected with vertigo, more persistent than previously, and with headache. At 2 P. M.

on the following day she was seized with general convulsions, and continued insensible or nearly so, with occasional convulsive movements, till Monday, when she died comatose. The pia mater at the vertex, sides, and base of the brain had a cloudy appearance, and underneath it, in places, was a thick, creamy substance in small quantity, which, examined by the microscope, proved to be pus, the largest amount being near the pons Varolii. There was no tubercle under the meninges or elsewhere, and no appreciable fibrinous exudation. The meningitis, though of brief duration, was nearly general.

The only additional lesions noticed were moderate congestion of the brain and an increase in the quantity of the cerebro-spinal fluid.

If the disease be protracted three or four weeks, which is rare, or even less time, the exuded substance may undergo further changes, such as occur in simple exudations in other parts of the system. Thus, on the 30th of April, 1860, we made the post-mortem examination of an infant at the Nursery and Child's Hospital, who had symptoms of cerebral disease, it was stated for several weeks, but the exact time was not ascertained. Prominent among the symptoms referable to the cerebro-spinal system toward the close of life were the hydrocephalic cry and rigidity of the neck. The appearance at the autopsy was remarkable. The anterior half of the brain was completely encased in a deposit which had nearly the appearance of lard. It filled the fissures of Sylvius, and appeared slightly on the anterior aspect of the cerebellum. Examined under the microscope, this substance was found to contain numerous cells, among which could be distinguished some resembling pus-cells, but nearly all had undergone more or less fatty degeneration. Here and there was seen a large cell containing numerous small oil-globules, the compound granular cell of pathologists.

The brain itself in meningitis is usually hyperæmic. On making an incision through it, red points are seen upon the cut surface, which indicate the seat of the congested vessels. The inflammation rarely extends to the walls of the ventricles, but the choroid plexus is injected. In exceptional instances pus or fibrin is found in the lateral ventricles. In the infant, two and a half weeks old, whose case has already been alluded to, about two ounces of purulent fluid escaped on opening the left ventricle. A small amount of liquid of a similar character was contained in the right ventricle. The distention of the lateral ventricles with serum is one of the common results of meningitis. This fluid is clear or straw-colored, or it is turbid in consequence of being mixed more or less with the softened brain-substance. The quantity does not exceed, two, three, or four ounces, and is often not more than one ounce or an ounce and a half. The distention of the two ventricles is ordinarily uniform, as they are united by the foramen of Monro, but now and then one ventricle is found more distended than the other. If there be considerable effusion, the brain is compressed and the convolutions have a flattened appearance, unless the cranial bones are still separated so as to yield to the pressure. If the sutures and fontanelles be open the cranial arch is expanded, sometimes quite perceptibly to the eye. From the same cause the anterior fontanelle, if open, is elevated. The foramen of Monro is enlarged according to the amount of effusion, and

the portions of the brain which separate the ventricles are sometimes lacerated. In many cases the cerebral substance surrounding the lateral ventricles is softened. The softening is found in all degrees, from the least appreciable deviation from the normal consistence to a state of diffluence, so that the brain presents the appearance of cream. Hypotheses have been advanced to explain the cause of this change in consistence, which are not entirely satisfactory. Whatever the explanation, the fact is attested by all observers, though there are exceptional cases. Thus Dr. West has records of the condition of the brain in fifty-nine cases, in thirty-seven of which there was considerable softening, and in the remaining twenty-two the consistence was normal.

Since a majority of the cases of meningitis in children are basilar, and portions of all the cerebral nerves lie at the base of the brain, it is easy to understand why the functions of these nerves are so seriously impaired in this disease. Compression of these nerves, or extension of inflammation to their sheaths, affords explanation of many of the symptoms, as the sighing respiration, abnormalities of the eye, etc.

Although the above remarks relating to the anatomical characters of meningitis are applicable to a large majority of the cases, I must confess that I have sometimes been disappointed at the autopsies of young infants who died with all the symptoms of meningitis in not finding more lesions. Moderate hyperæmia of the pia mater, its slight opacity or cloudiness at the base of the brain or elsewhere, with the presence of a few wandering white corpuscles, without any fibrinous exudation, with no increase of liquid external to the brain, but a considerable increase of it in the lateral ventricles, and hyperæmia of the choroid plexus, with nearly natural appearance and consistence of the brain, have in some instances been the only lesions when I had expected to find marked anatomical changes.

I am fully convinced from my own observations that, in some instances, physicians who supposed that they were treating tubercular meningitis, and at the autopsies discovered within the cranium tubercles, without any inflammatory lesion, but with a larger increase of the cerebro-spinal liquid, have been treating cases in which in addition to the meningeal tubercles, which were latent, the bronchial glands were tubercular and cheesy, so that by their increased size they compressed the venæ innominatæ within the thorax, thus preventing the free flow of blood from the brain, and causing, as I have elsewhere stated, cerebral and meningeal congestion, with more or less transudation of serum, but with no meningitis.

Causes.—The causes of non-tubercular meningitis are not fully ascertained. Active cerebral congestion frequently occurring, however produced, appears to be one of the common causes in young infants. In at least three instances I have known meningitis occur in infants between the ages of four and eight months, after severe and protracted bronchitis, which had been attended with the usual heat of head. The disappearance of eruptions upon the scalp, at or immediately before the commencement of the meningitis, has also been observed. I have witnessed it at the commencement of non-tubercular meningitis, as well as of meningitis which, if not tubercular, occurred at least in a decidedly scrofulous state of system.

The direct effect of the solar rays upon the head, and the prolonged action of a high atmospheric temperature, even without direct exposure of the head to the sun, are common causes during the summer months in New York City. I once attended a child with this disease who had been much exposed bareheaded to the direct rays of the sun in August and September, and at his death, which occurred toward the close of the hot weather, found hyperæmia, opacity, and fibrinous exudation in the pia mater at the summit of the brain, while the base of the brain seemed nearly or quite normal.

Dr. Soltmann,[1] of Breslau, reports three cases, in which intense cerebral hyperæmia, and probably meningitis, occurred from solar heat. In all three children the attack was sudden, the febrile movement and heat of head intense, and the progress rapid. The first had convulsions, the second automatic movements, and the third, the oldest, aged four years, when able to speak, complained of violent headache.

The statistics of New York City show that congestive and inflammatory maladies of the brain and its covering are more common during July and August, which are the months of maximum atmospheric heat, than in other months of the year. For example, in July and August, 1875, one hundred and sixty-seven died of these maladies, or one in every nine and eight-tenths who died from local disease, while during the entire year only seven hundred and ten died from the same, or one in every fifteen who perished from local diseases.

July, 1876, in New York City, was characterized by excessive and long-continued atmospheric heat, the temperature of the Central Park Observatory in the shade never falling below 61°, though never above 98°, and having a mean of 82.9° There was also unusual dryness of the atmosphere, since during the entire month prior to July 30th, there were only fourteen hours of rain, with a rainfall of 0.77 of an inch, and the average atmospheric humidity was represented by 65, saturation being denoted by 100. During this month I treated in my private practice four fatal cases, all between the ages of two and seven years, which I diagnosticated meningitis, none of them presenting any symptoms of otitis or tuberculosis. It would seem that the atmospheric heat had much to do with the development of the disease in these cases. One died in two days, but in the others there was the usual duration.

A not infrequent cause, especially among the strumous families of cities, is otitis media, and caries of the petrous portion of the temporal bone, the inflammation extending to the meninges. Since tubercular meningitis is due to the irritating effect of tubercles in or under the pia mater, it usually occurs where tubercles are most abundantly developed, that is, at the base of the brain, and along the course of the vessels in the inter-gyral spaces. The inflammation is commonly excited when they are still small, even minute.

Premonitory Stage.—Meningitis is usually preceded by symptoms which, if rightly interpreted, are of the greatest value. In most cases of this malady which I have seen, there was a prodromic period, varying from a few days to several weeks. The symptoms of this period

[1] Jahrbuch f. Kinderkrank. for October, 1875.

are obscure, and are liable to be mistaken for those of other and distinct affections.

The child in whom meningitis is approaching loses his accustomed vivacity and cheerfulness. He has a melancholy and subdued appearance, being quiet for a few minutes, and then fretful, without apparent causes. He can sometimes be amused by his playthings or companions for a brief period, when he turns from them with evident displeasure. Unexpected and loud noises and bright lights are evidently painful. If old enough to describe his sensations, he complains of transient dizziness, and at other times of headache. His ill-humor, if his wishes are not immediately gratified, or if they are denied, is often scarcely endurable on the part of friends, who are ignorant of the cause. There is great difference, however, in different cases, as regards this symptom. Some are inclined to be taciturn and quiet, while others are almost constantly fretting. The appetite is capricious; at one time it is pretty good, at another it is poor or even entirely lost. The patient may take a few mouthfuls of food, or, if an infant, nurse for a moment, when his hunger appears satisfied, and he will take nothing more. The bowels are regular or inclined to constipation. The pulse is natural, or it has times of acceleration, especially in the latter part of the day and toward the close of the premonitory stage. The duration of this stage is very different in different cases. Upon an average it is perhaps about two weeks, but it is often longer. In tubercular meningitis the symptoms, both during the inflammation and previously, are often complicated by those which arise from tubercles in other parts of the system.

Unless the prodromic period be of short duration, the effect of imperfect nutrition is obvious before it closes. The flesh becomes soft and flabby, or there is emaciation, though generally slight. The patient loses his strength, becoming less able to stand or to walk, and more easily fatigued. Occasionally, especially in the non-tubercular form, premonitory symptoms are absent, or are slight and of short duration.

Symptoms.—Dr. Whytt, living in the last century, when the tendency was toward refinement rather than simplicity in classification, divided meningitis into three stages, according to the symptoms, especially the pulse. Many subsequent writers, following Whytt's example, have recognized three stages, based not upon the anatomical characters of the disease, but upon the succession of symptoms. Such division of meningitis is in great measure arbitrary, since in one case the same symptoms occur at an earlier period than in another.

When the premonitory stage has passed, and inflammation is developed, some of the symptoms which were previously present remain and are intensified, and other new and more characteristic symptoms appear. There are now fewer intervals of apparent improvement. The child is quiet, often lying with his eyes shut. If aroused, he has a wild expression of the face, and is irritated by attempts to engage his attention or amuse him. He rarely smiles, or takes his playthings, or he notices them for a moment, when he turns away with disgust. During sleep there is often at first a placid expression of countenance, but when aroused he has the aspect of real sickness; the eyebrows are sometimes contracted, as if from headache; the features wear a melancholy look,

and are turned away to avoid the gaze of the observer or to shun the light. If the anterior fontanelle be open, it is observed to be prominent and pulsating forcibly. If consciousness be not lost, and the patient be of sufficient age, he complains of headache, or of pain in some part of the body. The tongue is moist, and covered with a light fur; the appetite is lost or poor; there is seldom much thirst; more or less nausea and constipation are present. As the inflammation continues, and usually within three or four days from its commencement, symptoms arise which dispel all doubts, if there were any, as to the nature of the disease. The vital powers are now evidently beginning to yield. The surface generally is more pallid, and there is the curious phenomenon of the sudden appearance, and, after some minutes, disappearance, of spots or patches, or even streaks of active congestion upon the face, forehead, or the ears. These, having a bright red color, contrast strongly with the general pallor. Ordinarily they are irregularly circular or oval, and from one inch to an inch and a half in diameter. A red spot or streak is also produced if the finger be pressed upon the surface or drawn forcibly across it. It continues a few minutes and then gradually fades. Trousseau calls attention to this fact as a diagnostic sign.

Another curious phenomenon is the variation in temperature. The face and limbs at one time feel quite cool, and after some minutes, without any excitement or other appreciable cause, the temperature rises, so that the surface is warm to the touch.

Consciousness, in severe cases, may be lost at an early period. On the other hand, I have known it in a case of moderate severity to remain, though partially obscured, till within twenty-four or thirty-six hours of death. The patient will usually open his mouth for drinks which are placed to his lip, when there is no other evidence of intelligence, and when sight and hearing are evidently lost.

The loss of the senses constitutes an interesting but melancholy feature of the disease. Among the first unequivocal symptoms, and frequently the very first, are such as pertain to the eye. This organ should be watched from day to day when the diagnosis is uncertain. Deviation from its normal state affords evidence of meningitis. The pupils are seen to dilate or contract sluggishly by variations in the intensity of the light, or they are not of the same size with those of another individual to whom the same amount of light is admitted. Sometimes the first perceptible deviation from the normal state is an inequality in the size of the pupils; while in others oscillation of the iris is observed. Later, when convulsions have occurred, the parallelism of the eyes is lost. After effusion has taken place, the pupils are commonly dilated. As death approaches, the eyes become bleared, and a puriform secretion collects in the inner angle of the eye and between the eyelids. This secretion is not abundant, but it is sometimes sufficient to unite the lids. The sense of hearing is probably lost as soon, or nearly as soon, as that of sight, but the sense of touch continues longer. The tongue is covered with a moist fur, unless near the close of life, when it is sometimes dry. The appetite is gradually lost, but often drinks are taken with apparent relish, even when there is no other evidence of consciousness. There are two

symptoms pertaining to the digestive system which are rarely absent, and which possess great diagnostic value; one is vomiting, the other constipation. In some patients, irritability of stomach begins at so early a period that it is really prodromic; it is rarely absent. Barrier collected the records of eighty patients with meningitis, and in seventy-five of these this symptom was present. It is due to the intimate relation existing between the stomach and brain, through the ganglionic system of nerves. The vomiting occurs without effort, and usually at intervals, for several days. It is a sudden ejection of the contents of the stomach, apparently without preceding or subsequent nausea. It contrasts, therefore, with the vomiting due to an emetic, which is attended by distressing symptoms. With some it occurs frequently, with others not more than two or three times daily. Commencing in the first stages of meningitis, or even prior to it, it occurs less often as the drowsiness becomes more profound, and finally ceases. Constipation is also present, usually from the commencement of the meningitis. It is one of the most constant and persistent symptoms, continuing through the entire sickness, unless relieved by medicine, or unless there be a coexisting diarrhœal affection. Often, when diarrhœa precedes the meningitis, it ceases the moment the latter commences. The constipation in this disease is easily overcome by purgatives. Several writers speak of retraction of the abdomen as a sign of meningitis. A hollow or sunken appearance of the abdomen, according to Gölis, aids in distinguishing meningitis from fever. The anterior abdominal wall approaches the spine, so that the pulsations of the abdominal aorta are distinctly felt. Rilliet and Barthez, who have rarely observed this retraction except in cerebral diseases, attribute it to the state of the intestines rather than to the action of the abdominal muscles.

The pulse in the first stages of meningitis is accelerated, or it is nearly natural during certain hours and afterward accelerated. When the disease has continued a few days, often not more than three or four, the pulse undergoes a marked change. It becomes slower, and at the same time irregular. The irregularity usually consists in an intermittence of the pulse after each six or eight beats. Sometimes the force of the pulse varies, so that a feeble pulsation is succeeded by one of greater volume and strength. The decrease in the frequency of the pulse cannot fail to arrest attention. From 110 or 120 beats per minute in the first stage of the inflammation it often descends to a frequency even less than the normal adult pulse. At an advanced period, as death approaches, the pulse again becomes accelerated and feeble.

The change in respiration is as decided as that of the pulse. In the beginning of the meningitis respiration is sometimes moderately accelerated, but in other cases it is natural. When the disease has continued a few days, the time usually varying from three or four to more than a week, a marked alteration occurs in the respiratory movements. Their rhythm, like that of the pulse, is changed. The breathing is irregular, intermittent, and accompanied by sighs. The change in pulse and respiration corresponds with the loss of consciousness, and shows that the brain is becoming seriously involved.

When the pulse and respiration undergo the changes which have been

described, another prominent and grave cerebral symptom is often present, namely, convulsions. Its occurrence diminishes greatly the prospect of a favorable issue. The severity and extent of the convulsive movements vary in different cases. They may be partial or general. Their duration is often brief, but they recur three or four times through the day. They are preceded by cephalalgia in those old enough to express their sensations, and often by drowsiness. Each convulsive attack ends in still greater drowsiness.

With this group of symptoms another should be mentioned. I refer to the hydrocephalic cry. At intervals the patient, without being disturbed, and without any change in symptoms, utters a scream or sharp cry, and immediately relapses into his former state. This cry is more common in the commencement of the meningitis than subsequently, and in many it is absent or is not a marked symptom. The glandular system participates in the general loss or derangement of function. Tears are seldom shed, even when the child is much irritated, and the urinary secretion is diminished. The small amount of urine passed sustains an important relation to the progress of the disease and the therapeutics.

The patient usually lingers several days after the pulse and respiration are changed in the manner stated. The drowsiness becomes more profound, the vomiting ceases, as well as the convulsive attacks, and sensation and consciousness are entirely lost. But even in this state, if nutriment and stimulants be administered with regularity, the child often lives several days longer than appeared possible. At length increasing feebleness and rapidity of pulse and coldness of the face and limbs indicate the near approach of death, which occurs in a state of coma.

The symptoms described above are such as we observe in ordinary cases of meningitis, and in the order which I have indicated. But he will be disappointed who expects that the above description will apply to all cases.

Meningitis may be so violent and rapid that both the character and succession of symptoms are different from those which have been stated. Thus, I have related the case of a girl, who, with no prodromic symptoms excepting occasional dizziness and slight headache, was taken sick on Thursday, had convulsions on Friday, and from this time continued either in convulsions or coma till her death on Monday. Again, even in cases of the usual duration and anatomical character, some of the most prominent symptoms upon which we rely for diagnosis may be lacking. The following was a case of this kind:

Case.—On the 5th of April, 1862, I was asked to see a boy two years and eight months old, of healthy parentage, and who, during the preceding year, had been in uniform good health, but previously had had two or three severe attacks of sickness. His head was unusually large, and whenever much indisposed he often had symptoms premonitory of convulsions, which were always, however, prevented.

One night, in the latter part of March, his parents noticed that his sleep was restless, but on the following day he seemed entirely well, and the restlessness at night was attributed to a late and hearty supper. On succeeding nights, however, he was restless, and, when questioned, com-

plained of pain in the abdomen. In a few days he was observed to be drooping in the daytime, and his appetite was not quite so good as previously. He had continued in this way about a week when my first visit was made.

The abdominal pain had at this time become more constant, but was never severe or accompanied by moaning. When asked where he felt sick, he placed his hand upon the epigastrium, pressure upon which was sometimes tolerated, but at other times painful. The following symptoms were noted: tongue slightly furred, anorexia, thirst, constipation, scantiness of urine, no headache or unusual heat of head during any part of his sickness. He vomited at intervals from about the 7th to the 10th of April, when the irritability of stomach ceased, and there was no return of this symptom.

About April 7th, the respiration was first observed to be irregular and sighing, and the pulse intermittent. These symptoms, so tardily developed, were the first which indicated cerebral disease. He now lay most of the time in bed, with eyes closed, surface commonly pallid, with occasional rose-colored spots or patches upon the cheek or forehead. The pupils responded to light in the usual manner till near the close of life, but bright lights were painful; the last two or three days of his life the left pupil was more dilated than the right. He had no convulsions or any spasmodic movement, and was conscious till within a few hours of death; the mother states that there was unequivocal evidence of his recognition of her on the last day of his life. He died April 17th, nearly three weeks after the commencement of the disease, and ten days after the commencement of symptoms which were clearly referable to the brain.

Autopsy.—Abdominal organs healthy, though epigastric pain had been so constant and prominent a symptom; brain and its membranes somewhat injected. The meninges covering the base of the brain from the most prominent part of the pons Varolii to the first pair of nerves presented evidences of inflammation. There was such opacity of the pia mater in places as to conceal the brain from view. The anterior and middle lobes of each hemisphere were glued together by fibrinous exudation, and on the left side, along the fissure of Sylvius, was a thick deposit of the same character. The lateral ventricles contained about an ounce of clear serum, and about half an ounce escaped from the base of the brain. The foramen of Monro was considerably enlarged, and the brain-substance surrounding the lateral ventricles was softened.

In this case it is seen that the prominent symptom, and, indeed, almost the only marked symptom in the first stages of the disease, was pain in the abdomen, and yet the abdominal organs were healthy. At the very moment when it was highly important that a correct diagnosis should be made, the evidences of cerebral disease were lacking. This case is, therefore, interesting on account of the variation in symptoms from those in the usual form of meningitis. There were no convulsions, and consciousness was retained as well as vision till near the close of life, and yet the lesions were such as are commonly present in meningeal inflammation. It is in such cases that a wrong diagnosis is frequently made, to the injury of the patient and the reputation of the physician.

Occasionally meningitis may continue so long as almost to justify its being called chronic, even when there is a large amount of exudation

upon the pia mater. In the few cases which end favorably, the symptoms abate gradually. I shall describe more fully the termination in speaking of prognosis.

Diagnosis.—It is of the utmost importance to diagnosticate meningitis in its first stages, since treatment, to be successful, must be commenced early. Certain writers describe at length the means of diagnosticating the simple from the tubercular form of the inflammation. Differential diagnosis is often difficult, and sometimes impossible; but it matters little, practically, whether the form of the disease be ascertained. On the other hand, it is very important, in order that the treatment be appropriate, to diagnosticate the premonitory or initial stage of meningitis from certain other affections not located within the cranium. Sometimes remittent or continued fever, or constitutional disturbances arising from irritation in the digestive system, simulate closely incipient meningeal disease, so that the greatest care and discrimination are required in order to make a correct diagnosis. Within a comparatively recent period I have known, in three different instances, experienced physicians of this city mistake commencing meningitis for fevers, not aware of the serious error they had made till the inflammation had reached a stage from which recovery was impossible. In order to avoid error in the diagnosis in the premonitory or initial stage of meningitis, the physician should take time to observe the physiognomy, and note every symptom. More than one protracted visit is often required to remove doubt as to the exact pathological state.

Meningitis is usually preceded and in its commencement accompanied by greater restlessness, fretfulness, intolerance of light, and a greater variation of symptoms than most other maladies. One familiar with the physiognomy of infancy and childhood, will discover in the features indication of greater suffering, of more serious sickness, than is commonly present in other maladies which simulate this.

Sometimes the sudden disappearance of a chronic eruption upon the scalp will aid in the diagnosis. This is a sign of importance, taken in connection with the symptoms. Headache and vomiting, symptoms of early occurrence, should especially arrest attention, or, in absence of headache, pain of a neuralgic character in some other part. But we may repeat that familiarity with the symptoms of meningitis will not protect from error if the visits of the physician are hasty, and his examinations imperfect. When the eyes become affected, the respiration and circulation irregular, and especially when convulsive attacks begin, diagnosis is easy. In fact, an incorrect diagnosis would then be unpardonable; but, unfortunately, if proper treatment have not been commenced till this period, it will be of little service.

Prognosis.—Meningitis is one of the most fatal maladies of early life. Whether the form be tubercular or not, if the initial stage have passed without proper treatment, death may be considered inevitable. Tubercular meningitis, however early recognized, is rarely amenable to treatment. M. Guersant[1] believes that recovery from the first stage of this form of meningitis is possible. "In the second stage," says he, "I have not seen one child recover out of a hundred, and even

[1] Dict. Méd., t. xix. p. 403.

those who seemed to have recovered have either sunk afterward under a return of the same disease in its acute form, or have died of phthisis. As to patients in whom the disease has reached its third stage, I have never seen them improve even for a moment." The very few reported cases which resulted favorably may have been, as M. Guersant has intimated in the context, cases of the non-tubercular form. Rilliet and Barthez believe that in a few instances tubercular meningitis has been cured in its first stage, but they state also that it is apt to return.

The prognosis in non-tubercular meningitis is not so unfavorable, provided that treatment be commenced at a sufficiently early period. It is now generally admitted that it may not infrequently be averted, when threatening, and even arrested in its incipiency. In many such cases we cannot, from the nature of the disease, be certain that the diagnosis is correct. But when we see children relieved, who present precisely those premonitory and even initial symptoms which occur in meningitis, we must believe that at least some of them would have had the genuine disease if not relieved by the measures employed. That in its commencement, recovery is possible from non-tubercular meningitis is also obvious from the fact that a few recover even in the second stage, when there can be no error of diagnosis.

Although a considerable proportion of patients with epidemic cerebro-spinal meningitis recover, even when the symptoms have been most grave, I have known only two recoveries from sporadic meningitis when it had reached that stage in which the functions of the brain and cranial nerves were impaired. One of these recovered with permanent loss of sight, the other with loss of hearing. Both seem to have ordinary intelligence. Another case has been communicated to me, in which the patient, a little child, recovered completely, but for several months after the attack seemed nearly idiotic.

Sometimes even in the second stage of meningitis, treatment properly employed is attended by amelioration of symptoms. Though such improvement may serve to encourage physician and friends, it should not be the basis for a favorable prognosis unless it continue three or four days.

Apparent improvement during a few hours or a considerable part of a day, is not unusual in those who finally die. Thus, in an infant whose bowels were previously confined, I have known the pulse and respiration to become more regular and the symptoms generally improve, though only for a brief period, by the action of a purgative. Dr. Watson says of the advanced stage of this disease, it is "often attended with remissions, sometimes sudden, and sometimes gradual, deceitful appearances of convalescence. The child regains the use of its senses, recognizes those about him again, appears to his anxious parents to be recovering, but in a day or two it relapses into a state of deeper coma than before. And these fallacious symptoms of improvement may occur more than once."

Most fatal cases of meningitis terminate between the third or fourth and the twentieth day, the duration varying according to the extent and intensity of the inflammation, and the vigor and age of the patient. But there are cases in which it may continue much longer. It is surprising sometimes how long the patient lives, when the symptoms are such that

death seems impending. Sensation and consciousness may be extinguished, convulsions occur at intervals, and the surface have acquired almost a cadaveric aspect, and yet the patient lives on. Rilliet and Barthez say: "Often have we inscribed upon our notes *death imminent*, and been astonished the next day to find still alive children to whom we had scarcely allowed two hours of life." The symptom which I have found to be the most reliable prognostic of the near approach of death, has been a pulse gradually becoming more frequent and feeble, though other symptoms remain as before. This change in the pulse is usually very apparent during the last twenty-four hours of life.

Treatment.—Such remedial measures should be prescribed during the premonitory stage as are calculated to relieve the fretfulness or irritability of temper and quiet the action of the brain, and, at the same time, produce a derivative effect from this organ. To this end the patient should be kept from all causes of excitement, and the bowels should be opened daily, if not naturally, by the use of proper medicines. A mustard foot-bath at night and occasionally through the day is useful, as it produces both a derivative and soothing effect. It will commonly produce a few hours' undisturbed rest, while all other measures except medicines fail. If dentition be taking place, and the gums are swollen, it has been the practice to employ the gum lancet, and still is with some physicians, but I for one have discarded its use for this purpose. Restlessness from dentition or restlessness premonitory of meningitis, requires decided doses of bromide of potassium, which will relieve the symptoms more effectually than the lancet. Three grains should be given to a child of six months, and four grains to one of ten or twelve months, and repeated if necessary in two to four hours. If symptoms indicate the near approach of meningitis, or its incipiency, the head should be kept constantly cool by a cloth wrung out of ice-water, or, better, an India-rubber bag containing ice, and cantharidal collodion should perhaps be applied behind one or both ears, over a space one inch in diameter.

Many children who are threatened with meningitis are scrofulous. They have already shown symptoms of tubercular disease. They are perhaps, to a certain extent, emaciated, and may have been affected with a cough. The premonitory symptoms in these children indicate the approach of the tubercular form of meningitis, and a more sustaining course of treatment is required than in those who are robust. To such children cod-liver oil may be profitably given, three times daily, together with the syrup of the iodide of iron, and perhaps the bromide. They should also be taken into the open air, with proper precautions, and every hygienic measure should be employed which will be likely to invigorate the system without exciting the brain.

Loss of blood is not, in general, required during the prodromic period nor in the disease. Those of a strumous cachexia, or those, whether strumous or not, who are under the age of two years, do not, unless in very rare instances, require depletion by leeches, much less by venesection. There is one class of patients in whom the early loss of blood may doubtless be of service, namely, those, who in a state of robust

health are suddenly seized with inflammation. Leeches may then be applied to the head of the patient, if he be seen at an early period.

Often, notwithstanding the measures employed, the patient grows worse, the symptoms become more continuous, others more alarming arise, and meningitis declares itself. Whatever the cause of the inflammation, and whatever modifications of treatment were required in the premonitory stage, on account of special indications, the purpose now is to subdue the inflammation by every resource in our art, which does not injure or too much prostrate the system. In former days calomel was largely employed as the main remedy in this disease, but when administered daily it has a very depressing effect, and it is to be borne in mind that in meningitis the vital powers progressively fail on account of the loss of appetite, vomiting, etc. In tubercular meningitis depressing treatment is, of course, strongly contraindicated, cases having occurred in which calomel was given at short intervals for several successive days, so as to produce a laxative effect, and though the meningitis seemed to be controlled, death occurred from exhaustion, or from some intercurrent affection, the result of the exhaustion. Thus in one case related to the class by a distinguished professor in New York City, fatal gangrene of the mouth supervened from the mercurial treatment, after the meningeal inflammation had apparently subsided. Although calomel during these last years, has been properly discarded as the main remedy, and its daily use rejected, nevertheless it is very useful as an occasional laxative in the more robust cases, if not given too near the iodide of potassium, and it is especially indicated as a derivative from the head in children of four or five years, who, previously hearty and strong, have become suddenly affected with meningitis, as from exposure to the sun's rays, or from an injury. But I repeat the belief that, in ordinary cases, calomel should never be employed, except as an occasional laxative.

The two remedies upon which we must chiefly rely are the iodide of potassium and the bromide of potassium or sodium. While the bromide quiets the restlessness, prevents convulsions, and diminishes, there is reason to think, to a certain extent, the hyperæmia, the iodide is useful as a sorbefacient, and it probably has some control over the inflammation. The iodide or bromide can be given together or separately.

The iodide should, like the bromide, be given early. If by a careful examination the absence of any other local disease, or constitutional disease, which might give rise to the symptoms be ascertained, and the symptoms indicate the meningeal disease, the iodide should be immediately prescribed. Obscurity often hangs over meningitis at this early stage, but it is better to give the iodide, even if the diagnosis be wrong, and no inflammation have commenced, than to err on the other side, and withhold it in the initial period of the true disease, for it is not an injurious remedy like calomel, and to exert any marked curative effect it should be given in the commencement of the inflammation. An infant of the age of six to twelve months should take two grains every two hours, and older children a proportionate dose. At the same time the bromide should be given in doses twice as large as that of the iodide, if the indications for its use are present, namely, headache, restlessness, and symptoms which threaten eclampsia. The bromide is a harmless

remedy given frequently for a limited time. With the regular and continued use of the iodide and occasional doses of bromide, the quantity of urine is in most cases largely increased. If the patient's condition do not soon begin to improve with such treatment there is no remedy.

If convulsions occur the bromide should be given every ten or fifteen minutes till they cease. If they be not controlled by the bromide, an injection, *per rectum*, of three to five grains of hydrate of chloral in a teaspoonful of water should be used in addition. Compresses wrung out of cold water frequently applied to the head, or a bladder containing pounded ice, and separated by one thickness of muslin from the head, materially aid in reducing the meningeal hyperæmia. Ergot, recommended by Brown-Séquard for its supposed effect in diminishing the hyperæmia in the inflammatory diseases of the nervous centres, should also be employed as an adjuvant in the treatment of this disease.

In the first stage of simple meningitis the diet should be mild and in moderate quantity, but in the tubercular form it should from the first be of the most nourishing kind, consisting of beef-tea, milk-porridge, etc. At a more advanced stage in both forms of the malady the most nutritious diet should be allowed, but alcoholic stimulants should not be given unless near the close of life when the vital powers are failing. The apartment should be cool and quiet.

CHAPTER X.

SPURIOUS HYDROCEPHALUS

The disease known as spurious hydrocephalus might with more propriety be called spurious meningitis. It received its appellation at the time when meningitis of early life was believed to be essentially a hydrocephalus, and was so called. Attention was first directed to this malady by London physicians of the last generation, particularly by Drs. Gooch, Abercrombie, and Marshall Hall, and little can be added to their description of its symptoms.

Anatomical Characters.—This disease, though resembling meningitis, in certain of its phenomena, is not in its nature inflammatory, nor is it primary. It is the result of some malady often chronic, but occasionally acute, which has produced exhaustion, especially of the nervous system. When it commences, there is usually more or less emaciation, and the symptoms of the primary disease are present. To this disease the lesions pertain which are found in other organs beside the brain.

The state of the brain in spurious hydrocephalus is not the same in all cases. In some there is no appreciable anatomical alteration in this organ. There is no apparent difference, either in the meninges or the

brain itself, from the condition which we often observe in those who have died of diseases which do not affect the cerebro-spinal system. In such cases the pathological state is simply deficient innervation, or if there be a structural change in the minute anatomy of the brain, pathologists have not yet discovered it.

The following case, which occurred in the Child's Hospital of this city, is an example of this form of spurious hydrocephalus:

Case.—A female infant, six months old, died on the 24th day of April, 1862, with the following history: It was wet-nursed, fleshy, and apparently well, till six days before death, when symptoms of gastro-intestinal inflammation were suddenly developed. The vomiting, especially, was severe, continuing forty-eight hours. When it ceased, drowsiness supervened, and continued till the close of life. The face during the four days of stupor was pallid and cool; eyes partly open, pupils sluggish, but of equal size; bowels rather torpid; anterior fontanelle depressed. When aroused, the infant noticed objects for a moment, and immediately relapsed into sleep; pulse accelerated and not intermittent, the day before death numbering one hundred and fifty; respiration accelerated, without sighing, numbering on the same day thirty. There were no convulsions, and death occurred quietly. The brain weighed twenty and a half ounces, and its appearance was perfectly healthy, both as regards consistence and vascularity. The amount of cerebro-spinal fluid in the ventricles and at the base of the brain was not notably increased. The stomach, small and large intestines, were vascular in streaks and patches.

In this case the cerebral symptoms were obviously due to exhaustion occurring at an early period, in consequence of the severity of the gastro-intestinal malady.

In a majority of cases, however, of spurious hydrocephalus, according to my observation, there is an anatomical alteration in the state of the brain and meninges. This consists in passive congestion of the veins, often with transudation of serum. At the same time the cranial sinuses are congested, and are found at the post-mortem examination to contain larger and more numerous clots than are present in those who die of diseases which do not affect the encephalon. Cases might be cited as examples. The cause of this congestion and effusion is, in great measure, feebleness of the circulation due to the general exhaustion of the patient. But there is another cause. In protracted diseases, especially those of a diarrhœal character, there is more or less wasting of the brain as well as of other parts. This naturally, by way of compensation, gives rise to congestion of the cerebral and meningeal veins and capillaries and to transudation of serum.

The transudation commonly occurs in this malady over the superior surface of the brain and in the subarachnoidal space, perhaps also more or less in the lateral ventricles. So common is it in the last stage of infantile entero-colitis, the summer epidemic of cities, that this stage, which is really spurious hydrocephalus, has been called the stage of effusion. I shall relate in another place examples which show the anatomical characters of this intestinal disease.

Symptoms.—Spurious hydrocephalus most frequently results from protracted diarrhœal complaints. It may, however, result from any

disease which is attended by great prostration. As it ordinarily occurs, the patient has for days or weeks been gradually losing flesh and strength. Finally, drowsiness supervenes, or before the drowsiness there is sometimes a period of irritability.

Marshall Hall describes two stages of spurious hydrocephalus. In the first he says: "The infant becomes irritable, restless, and feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched, or from any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose, and the evacuations are mucous and disordered." The second stage he describes as that of torpor. The first stage often, however, does not present those prominent symptoms which have been described by Dr. Hall, and this stage may even be absent, or not appreciable, especially in young infants.

Whether or not commencing with the stage of irritability, the disease, if not checked, gradually increases. The child soon becomes drowsy. He may be aroused for a moment, but, unless constantly disturbed, immediately relapses into sleep. He is sometimes fretful when aroused, but in other instances is quite indifferent, observing without apparent interest objects employed for the purpose of amusing him. Often there are indications of cerebral pain or distress, as contraction of the eyebrows, etc., but many of those affected are too young to make known their sensations. Convulsions sometimes occur toward the close of life, but they are not so common in this disease as in meningitis. When they do occur, they are generally partial and often slight. The pulse is accelerated in most patients prior to and in the commencement of spurious hydrocephalus. As the disease advances it becomes irregular and intermittent, and toward the close of life it is progressively more frequent and feeble. The respiration at first is not much disturbed, but at length it becomes irregular, like the pulse. It is feeble and accompanied by sighs. Occasionally there is slight cough. The eyelids are partly open, the pupils no longer respond to light, and in advanced cases they have a bleared appearance. The diarrhœa, which in most instances precedes and causes this malady, continues till the stage of stupor arrives, when the evacuations become less frequent or cease altogether. In infants the stools are frequently green, in older children brown and sometimes slimy. The febrile heat of surface which preceded the disease, and which was present in its commencement, disappears; the face and hands become cool, the features pallid, and the anterior fontanelle, if open, is depressed. Death finally occurs in a state of coma, or if the disease be recognized and proper remedial measures employed, the result may be favorable, even when the symptoms are such that if meningeal inflammation were the malady we would consider the case necessarily fatal.

The following case is an example of spurious meningitis as we often meet it in practice:

Case.—On the 13th day of March, 1859, I was asked to see a male child twenty-two months old, the records of whose case are as follows:

"Was well till about three weeks ago, since which time he has had

diarrhœa, with febrile symptoms; pulse 162, respiration 52; has a slight cough, with a few mucous râles; resonance on percussion of chest good; is somewhat emaciated, and appears languid; tongue moist and slightly furred. Has all the incisor and three anterior molar teeth, and the gum is swollen over the remaining anterior molar and two canine teeth."

"From the 14th to the 18th there was no material alteration in his symptoms, with the exception that the diarrhœa was partially restrained by Dover's powder in one and a half grain doses. On these five days the stools numbered daily from one to six. The pulse was uniformly frequent, varying from 124 to 156, and the respiration on two days, when its frequency was ascertained, numbered 56 and 46.

"March 19th, pulse 124; has become drowsy since yesterday, and when aroused is fretful. Omit Dover's powder. Treatment, cold applications to the head, mustard pediluvia.

"Evening, pulse 136; eyes constantly closed and head reclining; surface generally warm; tongue dry and furred; he vomited at first, but has not in three or four days. Apply cantharidal collodion behind each ear, and continue the local treatment.

"20th, pulse 130; is constantly sleeping, and when aroused is very fretful and soon relapses into sleep; no unnatural heat of head, and no dejection since yesterday. Treatment, a dose of castor oil, nourishing diet.

"21st, drowsiness as before; cheeks sometimes flushed, sometimes pallid; pupils sensitive to light; margins of eyelids covered with secretion. The bowels have been opened by the oil."

On the 22d and 23d there was no material change in the symptoms. He was constantly sleeping, except for a moment when shaken. More active stimulation was now employed. Brandy was prescribed, to be given every two hours; beef tea and milk porridge frequently.

On the following day, the 24th, he was more fretful, and less drowsy. Brandy and beef tea were continued.

On the 25th, with the same treatment, there was still further improvement; drowsiness nearly gone and less fretfulness than yesterday; rolls the head occasionally and does not appear to see distinctly; has a slight cough; stools nearly regular; pulse 100; respiration natural; surface warm, and no unnatural heat of head. The same treatment was continued, and he rapidly and fully recovered.

This case is interesting on account of the long duration of marked drowsiness, which continued five days, and yet the patient recovered entirely in the space of two or three days under the use of brandy and beef-tea.

In May, 1860, I was called to treat a very similar case. A child, twenty months old, had diarrhœa for two weeks, the stools being of a dark-brown color, thin and offensive. He was at first very irritable. The pulse was constantly above 130, and the respiration was correspondingly increased. The stage of drowsiness finally supervened, and for two days he was constantly asleep unless aroused by being shaken. During the somnolent stage the pulse numbered 140, respiration 36. The face and extremities were cool, and he finally had a slight convulsion. By stimulants and nutritious diet he began immediately to improve, and was soon out of danger.

In the following case the result was unfavorable. This case is interesting on account of the anatomical characters of the disease as disclosed

by the post-mortem examination. It is an example of that large class of cases in which spurious hydrocephalus is associated with congestion of the cerebral vessels and serous effusion. It is exceptional, however, as regards the long duration of drowsiness. Ordinarily, protracted diarrhœal maladies which end in passive congestion and effusion terminate fatally in three or four days after the drowsy period arrives.

Case.—"Dec. 13, 1861, called to-day to a German infant eighteen months old. It has had diarhœa four weeks without regular and proper medical attendance; stools from the first brown and thin; during the last eight or nine days he has been drowsy; when aroused, opens his eyes and is very fretful, but immediately the upper eyelids gradually droop, and, unless disturbed, he remains asleep with his eyes partially open; forehead warm, face cool and pallid, and limbs also rather cool; pulse 164, respiration 32; has had a slight cough about one week, and slight dulness on percussion over the left infra-scapular region; depression of infra-mammary region on inspiration. Treatment: Ammon. carbonat., gr. 1 every two hours; nourishing diet.

"Dec. 20th, has continued drowsy since the last record; pupils moderately dilated; a thick secretion between eyelids; right pupil considerably larger than the left; vision apparently lost during the last three days; pulse over 140; respiration 44 per minute, accompanied by sighing since the 18th; moans much when awake; rolls the head frequently; during the last six days the surface back of the ears has been constantly sore by vesication; takes the most nutritious diet, with brandy. The dejections remain thin and brown, and number three or four daily.

"From this date the diarrhœa continued, except as it was restrained by vegetable astringents. The pulse continued frequent, and a slight cough remained. There was on the 21st and 22d partial abatement of the drowsiness, but on the 23d it was greater than ever. The body was somewhat reduced at the commencement of the cerebral symptoms, but it was now considerably emaciated. The prostration increased daily, and the hands were observed to tremble. The face and hands became more cool, while the head was warm. On the 24th partial convulsions occurred, followed by coma and death.

"The cerebral veins and sinuses were generally congested, except in the anterior portion of the brain, where the appearance was normal. Between the brain and its membranous covering, chiefly at the vertex and the base, was an effusion of clear serum. The whole amount of this fluid was estimated at two ounces. On slicing the brain, numerous 'puncta vasculosa' were seen, both in the gray and white portions. With the exception of the congestion, the substance of the brain presented its normal appearance. No inflammatory lesions were present. We were not permitted to examine the condition of the intestines."

Diagnosis.—The only disease with which spurious hydrocephalus is liable to be confounded is meningitis. The points of differential diagnosis are the history of the case, especially the antecedent diarrhœa or other exhausting ailment, evidence of prostration when the cerebral malady commenced, depression of the anterior fontanelle if it be open, and the cool face and extremities.

Prognosis.—If the pathological state of the brain be simple exhaustion, the disease can often be arrested by judicious treatment. If an

incorrect diagnosis be made, and the treatment employed be that appropriate for meningitis, which it so closely simulates, death is almost inevitable. If transudation of serum have occurred, unless slight, the result is usually unfavorable, whatever may be the treatment. This disease in childhood is more easily managed than in infancy, but is less frequent. The prognosis is better in the cool months than during the heat of summer. It is more favorable if the child be over than if under the age of one year. The occurrence of an irregular and intermittent pulse, of respiration accompanied by sighs, of inequality in the pupils, or their sluggish movements, with increasing stupor, indicates an unfavorable issue. The cure of the primary disease, with the pulse and respiration still natural, or accelerated, without change of rhythm, pupils sensitive to light, drowsiness from which the patient is easily aroused to a state of entire consciousness, render recovery probable, with proper medication and alimentation.

TREATMENT.—The indications of treatment are twofold: first, to remove the primary pathological state which is the cause of the spurious hydrocephalus; and, secondly, to cure the latter. The first is important, since the successful treatment of a disease requires the removal of the cause. The measures employed for this purpose are pointed out in our description of the diarrhœal and other maladies which produce spurious hydrocephalus.

We may here say that as spurious hydrocephalus is due in a very large proportion of cases to the exhausting effect of long-continued diarrhœa, astringents, especially subnitrate of bismuth, and alkalies are required in a majority of cases in the stage of irritability, and sometimes also opiates.

Active sustaining measures are indicated. Exhausted nervous power, as well as passive cerebral congestion, requires this. The diet should be highly nutritious, comprising such substances as milk and beef-juice, and should be given frequently. Brandy is required at short intervals. Dr. Gooch was in the habit of giving the aromatic spirits of ammonia, properly diluted, as a quick and active stimulant. Six or eight drops may be given in sweetened water to a child one year old, and repeated every hour in cases of urgency. If, by proper treatment of the cause, and by the use of stimulants and nutritious food, the patients do not within a few hours become less stupid and more conscious, there is that degree of nervous exhaustion or of serous transudation from the engorged cerebral veins, which will render death probable. In some cases it is proper to produce moderate vesication behind the ears.

CHAPTER XI.

ECLAMPSIA.

The term eclampsia is used in a more restricted sense by some writers than by others. It is employed in the following pages to designate those convulsive seizures, clonic in their character, sometimes general, sometimes partial, which affect the external muscles. Eclampsia is therefore synonymous with clonic convulsions. It consists in rapid, forcible, and involuntary muscular contraction, alternating with relaxation. It is distinguished from chorea in the fact that the latter is a more permanent state, and is characterized by muscular movements which are partially under the control of the will, and are not so violent.

Eclampsia occurs in a great variety of diseases, some of which are located in the cerebro-spinal system, some in other parts of the body, and some are constitutional. It may also be produced by temporary derangements of system not sufficiently severe to be considered diseases, and by powerful mental impressions, those of an emotional nature, affecting the delicate and sensitive nervous system of the child. Pathologists recognize three different forms of eclampsia. The term essential or idiopathic is used when the convulsions have no appreciable anatomical character, that is, when there is no apparent pathological state in the brain or elsewhere, which gives rise to the attack. For example, if a child die in convulsions from fright, and all the organs, including the brain, are found in their normal state, the eclampsia is called idiopathic or essential. If the cause be disease of the brain or spinal cord, it is termed symptomatic. If eclampsia arise from local disease elsewhere than in the cerebro-spinal axis, as from pneumonia, the term sympathetic is employed. This is in the main a good division, but eclampsia may be at the same time sympathetic and symptomatic, as when it occurs in consequence of congestion of brain, which is induced by severe and frequent paroxysms of hooping-cough.

Causes.—Eclampsia occurs at any period of infancy and childhood, but it is much more rare after the period of six or seven years than previously. Some children are more liable to it than others. It is produced in one by an agency which in another has no appreciable effect. There are some, generally those of an impressible nervous system, who are seized with convulsions whenever there is any slight derangement in the digestive or other organs. Eclampsia is frequent in certain families. Thus, Bouchut mentions a family of ten persons, all of whom had convulsions in their infancy. One of them married, and had ten children, all which, with one exception, had convulsions.

The exciting causes of eclampsia are too numerous to be mentioned in full. It is a symptom in nearly all cerebral diseases. It is produced in the nursling by changes in the milk with which it is nourished.

These changes are usually due to violent emotions of the mother, as anger, fright, and grief, to the use of acescent or indigestible food, or to derangement, temporary or permanent, in her health. Thus, in a case related to me, the catamenia so affected the milk that the infant was seized with eclampsia at each monthly period. In childhood the most common cause of clonic convulsions is the presence of some irritant in the primæ viæ. All kinds of fruit, even the mildest, may produce eclampsia, especially when eaten unripe or taken in undue quantity. I have known an infant to be seized with convulsions from eating strawberries, which parents usually regard as harmless, and one of the most violent and protracted cases of eclampsia which I have witnessed, occurred in a child over the age of six years, from swallowing, in considerable quantity, the parenchymatous portion of an orange. Constipation, worms, dysentery, intussusception, and painful dentition are also causes which are located in the digestive apparatus. Inflammation in some part of the respiratory apparatus is a not infrequent cause. Thus eclampsia occurs occasionally in severe coryza, in consequence, according to some, of the proximity of the inflamed surface to the brain, and the consequent afflux of blood to this organ. It is a common complication also of pertussis and pneumonia. It occurs often at the commencement of two of the eruptive fevers, namely, smallpox and scarlet fever, and in the course of the latter disease.

Violent emotions of the child may also cause eclampsia. Bouchut relates the case of a girl, five years old, who was corrected before her companions, and was so affected by anger that convulsions ensued. Residence in close and overheated apartments, or in streets where the air is loaded with offensive vapors and is stifling, is a predisposing cause, so that there is a larger proportion of deaths from convulsions in the cities than in the country.

In young children, burns, even when not very severe, are liable to terminate suddenly in eclampsia, succeeded by coma and death. Urinary calculi, both renal and vesical, frequently produce the same result.

Such are the more common causes of eclampsia. It is seen that they are of two kinds, predisposing and exciting. An excitable or impressible state of the nervous system constitutes the chief predisposition to the disease. Plethora, or its opposite state, anæmia, increases the liability to an attack.

Premonitory Stage.—In the majority of cases there are prodromic symptoms, which the experienced and careful physician can detect, so as to forewarn friends. The child is perhaps more or less drowsy, and, when disturbed, fretful. The eyes often have a wild or unnatural appearance; occasionally they are fixed for a moment on an object, and yet apparently without noticing it. The sleep is disturbed; in some there is unusual heat of head, and, if old enough, complaint of headache. At times, especially if the primary disease be febrile or inflammatory, there is incoherence of thought or expression, or even actual delirium. In some children, when eclampsia is threatening, the thumbs are seen to be carried across the palms. I have observed this especially during the convulsive cough of pertussis. A very important prognostic symptom is sudden starting, or twitching of the limbs. This shows

that the nervous system is profoundly impressed, and but slight additional excitation is required to develop eclampsia. This sudden starting not infrequently precedes the attack several hours, and gives sufficient forewarning.

The prodromic symptoms are often disregarded by friends who do not understand their significance. Even physicians, in the haste of their visits, in many instances do not notice them. The symptoms which precede symptomatic and sympathetic eclampsia, are, moreover, blended with those of the primary affection, and hence another reason why they are frequently overlooked. When the convulsions are about to commence, the child generally lies quiet; the eyes are open and fixed. If spoken to or shaken, he takes no notice, and does not speak. The direction of the eyes is then changed; often they are turned up; occasionally there is strabismus. The face may be pale or flushed, and sometimes, especially in cerebral diseases, the features present patches or streaks of a flushed appearance, while around them the natural color is preserved. Immediately before the spasmodic movements the child sometimes utters a piercing scream, which is probably involuntary, though it seems like a supplication for help. The duration of the prodromic stage is very different in different cases. It may last from a few minutes to several hours, or even more than a day.

Symptoms.—Eclampsia is general or partial. If *general*, the muscles of the face, eyes, eyelids, and of all the limbs, are in a state of rapid involuntary contraction, alternating with relaxation. The features lose their natural expression and are distorted; the mouth is drawn out of shape, often to one side, by the violent muscular action; the teeth are pressed together by tonic contraction of the masseters, and may be violently struck together, so as to lacerate the tongue, if it protrude, or are ground upon each other. Unless the attack be of short duration, frothy saliva, perhaps tinged with blood from the injured tongue, collects between the lips. The eyelids are usually open, and in severe cases the eyes are turned so that the pupils are lost under the upper eyelids, or the muscles of the eyes are involved in the spasmodic movements, so that the eyeballs are forcibly drawn from side to side. Occasionally strabismus occurs. While the features are thus distorted, the head is strongly retracted or is turned to one side; the forearms are alternately pronated and supinated; the thumbs and fingers are convulsively flexed, so that the thumbs lie across the palms and are covered by the fingers; the great toe is adducted, the other toes flexed; and the toes, as well as legs, participate more or less in the spasmodic movements.

In general convulsions, consciousness is usually lost. The head is hot previously to and during the attack—at least in the first part of it—and the face flushed. In exceptional cases, especially in sympathetic eclampsia, the head is cool and the face pallid. The pulse is somewhat accelerated, as well as the respiration, and the latter is rendered irregular if the respiratory muscles, especially those of the larynx, are involved, as they generally are. The sphincters are relaxed during the convulsive attack, so that in many cases the urine and stools are passed involuntarily.

Partial eclampsia is more common than the general form; it occurs in the muscles of the face, including those of the eye, of the face and of one or both upper extremities, or of the face and the extremities on one side. The spasmodic movements may be even limited to the muscles of the eye, and they often occur only in these muscles and those of the face. Rarely, if ever, does eclampsia affect the legs without affecting also the muscles of the arms and face. In partial convulsive attacks, sensation and consciousness are in some patients not entirely lost, but in others they are not manifested if present.

The duration of an attack of eclampsia varies in different cases from a few minutes to several hours, with an average of not more than from five to fifteen minutes. The movements do not often continue longer than three or four hours in the severest cases. They are sometimes said to last a much longer time, even for days, but in these cases there are intermissions. Violent attacks are usually short.

When the convulsion ends favorably, the spasmodic movements become less and less strong, and finally cease. The child then takes a deep inspiration, after which it lies quiet, and the respiration remains regular or moderately accelerated. Some fully recover in a few minutes if the eclampsia have been light and the cause transient, and seem to experience no inconvenience except soreness of the muscles and fatigue. Others soon recover consciousness, and their temperature, respiration, and circulation become natural, but they remain dull for a time, their minds are bewildered, and they are perhaps unable to speak. In a few hours these untoward symptoms pass away. In essential, and in a large proportion of cases of sympathetic eclampsia, if properly treated, and if the cause be recognized and removed, there is no recurrence of the convulsion; with others it is different. In many cases, especially of symptomatic eclampsia and of sympathetic, in which the cause is grave and persistent, the convulsions return after a variable period of a few minutes or a few hours. Six or eight or more convulsions may occur within twenty-four hours. Rarely they occur several times daily for several consecutive days, but severe convulsions, repeated at short intervals for twenty-four or forty-eight hours, usually end in fatal congestion of the brain or serous effusion. I once attended an infant about six months old, who had from four to twelve convulsions daily for eleven days, caused probably by a vesical calculus, as there was dysuria, and, at times, bloody urine. Some days after the convulsions were controlled, while we were deferring exploration of the bladder, death occurred suddenly, and an autopsy was not permitted. This case will be detailed elsewhere. Bouchut has witnessed a case of hooping-cough in which there were daily convulsions for eighteen days.

In severe eclampsia, the respiration is so embarrassed and circulation so retarded that congestion of various organs results. This passive congestion in the respiratory organs is indicated by moist râles in the larynx and bronchial tubes; occurring in the brain, it is indicated by profound stupor. It has already been stated that death may occur from the cerebral congestion, which, continuing, is apt to end in effusion of serum or extravasation of blood. In these cases the convulsive movements cease, but there is no return of consciousness. The child lies

quiet, as if in sleep, with pupils not readily acted on by light, and often somewhat dilated; gradually the limbs grow cool and the pulse feeble, and fatal coma supervenes.

Death does not ordinarily occur from one attack. There are several at intervals, during which the stupor is gradually becoming more and more profound, till, finally, total loss of consciousness and sensation results, terminating in death. Apnœa may occur in the first attack, ending life abruptly and unexpectedly, but in other instances it does not result till after several seizures, when, at length, one more violent than the others interrupts the respiratory function and causes death.

Occasionally, when life is preserved, there is some permanent ill-effect of eclampsia. Bouchut says: "The origin of certain permanent contractions which bring on deviation of the head or of other parts, retraction of the limb, paralysis, etc., must be referred to the convulsions of the muscles. I have seen several children in whom torticollis had no other cause. The drooping of the upper eyelid, strabismus, irregularity of the mouth, severe contractions of the limbs, often depend on this influence. These accidents are consequences of essential as well as of symptomatic convulsions."

Anatomical Characters.—The morbid anatomy pertaining to eclampsia is in most cases twofold: first, the pathological states which precede and cause the convulsive movements; secondly, those which result from them. We have seen that in sympathetic eclampsia the diseases which sustain a causative relation are very numerous; some are constitutional, others local, and the latter may have their seat in almost any part of the economy, distinct from the cerebro-spinal axis. In some cases of sympathetic eclampsia the immediate cause is too active a circulation, a state of hyperæmia of the cerebral vessels.

It has already been stated that this hyperæmia may be diagnosticated in young infants in whom the anterior fontanelle is open. Such infants, seized with acute inflammation of the mucous surfaces or of the lungs, often present a full and rapid pulse and a convex and forcibly pulsating fontanelle before the eclampsia begins. In other cases of sympathetic eclampsia the primary disease induces passive congestion of the brain, and this in turn gives rise to convulsions. Eclampsia occurring during the paroxysms of hooping-cough affords an example. In the contagious diseases, as smallpox and scarlet fever, eclampsia is doubtless often produced by the direct action of the specific virus on the cerebro-spinal system. Therefore, in a considerable proportion of cases of eclampsia due to diseases not located in the cerebro-spinal system—in other words, of sympathetic eclampsia—the primary disease induces a pathological state of the cerebral vessels, or of the blood which circulates through them, which state immediately precedes and accompanies the convulsions.

In other cases of sympathetic eclampsia the convulsive movements are produced by the primary disease acting directly on the nervous system, through the medium of the nerves, without causing any appreciable alteration in the state of the cerebro-spinal axis. Thus Barrier relates three fatal cases of convulsions occurring in pneumonia, in none

of which was there anything abnormal in the condition of the brain or its membranes.

The pathological state preceding SYMPTOMATIC eclampsia differs in different cases, since convulsions occur in almost every disease of the brain and its membranes. The immediate cause of this form of eclampsia may be active or passive cerebral congestion, with or without effusion; it may be compression of the brain from various causes; it may be a deficiency as well as excess of the cerebro-spinal fluid.

In essential eclampsia the cause sometimes produces congestion of the brain prior to the convulsive seizure. In other cases, as when convulsions occur immediately from the effect of anger or fright, there is no appreciable change in the state of the nervous centres previously to the attack.

Again, eclampsia, especially when severe and protracted, and when occurring in successive attacks, may be the cause of certain lesions. It produces congestion of the brain and membranes, and perhaps of the spinal cord. Sometimes if the congestion be great, there is also escape of serum from the distended capillaries, and the fibrin in the larger vessels, as the sinuses, may coagulate.

Ths congestion resulting from eclampsia may give rise to extravasation of blood and the formation of a clot. If this accident occur, there is often paralysis affecting more or less of one side, permanently or gradually disappearing.

It may be difficult to decide whether the cerebral congestion precedes the eclampsia or is its result; but in those cases in which it precedes and operates as a cause, it is no doubt increased during the convulsive period. The spasmodic muscular action, by rendering respiration irregular and imperfect, also leads to congestion of the lungs and sometimes of the abdominal organs.

DIAGNOSIS.—The only disease for which there is danger of mistaking eclampsia is epilepsy, but the diagnosis can ordinarily be made by recollecting the following facts: Eclampsia is most common in infancy. If it occur after the age of three years there is some manifest exciting cause, which renders the child seriously sick independently of the convulsions, and prior also to their occurrence. Eclampsia very seldom occurs in one who has reached the age of three years, even with a strong predisposing cause, unless he have been subject to it during the period of infancy, as shown by his history. On the other hand, epilepsy rarely occurs before the age of three years. The first attacks of it are very often mild, the *petit mal* of writers, but in other cases they are tolerably severe from the first, but whether mild or severe, they occur with no previous or coexisting sickness, and with little or no warning.

Having seen a considerable number of epileptic children in the Bureau for the Relief of the Outdoor Poor during the last ten years, I have been surprised to learn how few had eclampsia when infants. It was exceptionally the case that a child having epileptic attacks commencing as ordinarily they did, between the third and tenth years, gave the history of infantile eclampsia, and yet the convulsive movements in the two diseases seem to be identical. I cannot agree with some that

the phenomena in eclampsia and epilepsy differ, except as the causes of eclampsia produce certain concomitant symptoms, and there is every reason to believe that the spasmodic muscular movements proceed from an irritation of the same portion of the cerebro-spinal axis, to wit, the medulla oblongata. Writers like Niemeyer have given reasons for the belief that spasmodic muscular movements are produced by functional disturbance of this part of the nervous centre. I may state the following, to which I am not aware that any one has alluded. If the exposed medulla of an acephalous monster be pressed or pinched, convulsions like those of eclampsia and epilepsy result. These two diseases, therefore, have a close resemblance anatomically and clinically, but by attention to the above facts they can ordinarily be distinguished from each other.

It is often difficult to ascertain the form of eclampsia, whether essential, symptomatic, or sympathetic—in other words, to determine the cause—till after the convulsions cease. This is especially true when, as is frequently the case, the physician is not summoned till the convulsive movements begin, and it is necessary that he should act promptly, with but little knowledge of the child's previous history. If there be an obvious antecedent disease, as hooping-cough or meningitis, the cause is apparent; but if the previous health have been good, or but slightly disturbed, it may be necessary to make more than one visit or examination in order to ascertain the seat and character of the cause. In the majority of cases of convulsions occurring suddenly in a state of previous good health, the cause is seated in the intestines, but sudden and unexpected attacks may be due to the commencement of some inflammatory affection, as pneumonia, or of a febrile disease, as smallpox. Unless the eclampsia be speedily fatal, the physician, if he examine carefully, will, in most cases, soon be able to ascertain the nature of the cause, and diagnosticate the form of the disease.

Prognosis.—Symptomatic eclampsia is always serious. If it occur in the course of a cerebral disease, it indicates the approach of death, but if at the commencement, some may recover. Its recurrence, whatever the cerebral disease, is an almost certain prognostic of death.

In idiopathic or essential convulsions the prognosis depends on the severity of the attack, and on the age, strength, and previous condition of the child. If there be predisposing or coöperating causes, as a nervous or excitable temperament, or dentition, the prognosis is less favorable than when such causes are absent.

In sympathetic eclampsia the prognosis varies greatly, according to the nature of the primary disease, and often according to the stage of that disease. If convulsions occur at the commencement of an eruptive fever, they generally subside without untoward symptoms, and the fever pursues a favorable course. Eclampsia, after the appearance of the eruption, is premonitory of a fatal result. I have not yet known a patient with scarlet fever recover who had convulsions after the rash had covered the body, and experienced physicians of this city tell me that their observations correspond with mine. Dr. J. F. Meigs, however, relates one favorable case. If the cause of the eclampsia be located in or upon the mucous surfaces, a majority recover with judi-

cious treatment. In convulsions consequent on pneumonia or a burn, more die than recover.

The prognosis in eclampsia is more favorable if the parallelism of the eyes be retained, the pupils remain sensitive to light, and consciousness soon return. A fatal termination may be predicted, if, after the convulsion, the child remain stupid, without any evidence of returning consciousness, and the pupils do not respond to light.

TREATMENT.—Fortunately, inasmuch as the physician is often required to treat eclampsia in ignorance of the cause, the same measures are demanded, to a considerable extent, in all cases, whether the form be essential, symptomatic, or sympathetic. As early as possible in the attack the feet should be placed in hot water to which mustard is added, or, if it can be procured with little delay, a general warm bath may be used in its place. This has a soothing effect upon the nervous system and promotes muscular relaxation, while it also produces derivation of blood from the cerebro-spinal axis. It is, therefore, useful, especially in those cases in which active or passive congestion precedes the eclampsia; it is also useful as a preventive of passive congestion and consequent œdema of the brain, lungs, and other organs, which are the most serious results of eclampsia. It should be continued from six to fifteen or twenty minutes, according to the severity and duration of the attack; at the same time cold applications should be made to the head, until its temperature, which is usually increased, is reduced. The application of cloths placed upon ice or frequently wrung out of cold water, is the most convenient and ready mode of employing this agent. Cold thus employed acts promptly in contracting the vessels of the brain and meninges, and diminishing the cerebral congestion. It tends, therefore, to remove one of the chief dangers.

Cold applications are also useful for reducing an elevated temperature, if it be present. In most cases of eclampsia, if the temperature reach 103°, the necessity for its reduction is urgent, and the cloths or India-rubber bag containing ice should be applied not only upon the head, but also along the sides of the face, and sometimes over the great vessels of the neck.

As a large proportion of convulsive attacks originate in the condition of the intestines, either solely or in part, it is advisable to prescribe an aperient unless there be previous diarrhœa.

The common enema of soap and water will usually produce a free and speedy evacuation, and will sometimes disclose the cause of the eclampsia in the expulsion of seeds or other indigestible substances or scybala. A cathartic is also often required, especially if the enema fail to produce sufficient evacuations. In those that are robust, and especially in those beyond the age of two or three years, calomel is an excellent purgative, is easily given, and is prompt in its action. If the symptoms indicate intestinal inflammation, the milder purgatives, as castor oil, are preferable, as they also are in young or feeble children. If the recent ingesta of the patient consisted of fruit or of substances of an indigestible character, an emetic is appropriate; a teaspoonful of the syrup of ipecacuanha, repeated if necessary in fifteen or twenty minutes, may be given to a young child, or this syrup mixed with the syrup. scillæ compositus

to one older and more robust. Aside from the ejection of the offending substance which it produces, an emetic has some effect in controlling the convulsive movements. But the cases are rare in which emetics are indicated.

In addition to the local measures mentioned above, and measures calculated to relieve the digestive canal of any offending substance, a safe medicinal agent which will act promptly in relieving the convulsions is urgently demanded, since eclampsia, if severe and protracted, involves great danger. Fortunately such agents have been lately introduced into therapeutics, namely, the bromide of potassium or sodium, and hydrate of chloral. These agents, while they are effectual, are safe, and, therefore, their use has supplanted that of the antispasmodics, asafœtida, valerian, lavender, and chloroform, formerly employed; not one of which, except chloroform, exerts any direct controlling influence over the convulsions, and chloroform is a dangerous remedy unless used sparingly.

The bromide of potassium, which I prefer, should be given every ten minutes, dissolved in cold water, till the convulsions cease, in doses of three grains to a child of one year, and of four or five grains to a child of two or three years. When the convulsions cease, the interval between the doses should be lengthened. In one instance in my practice an infant of eighteen months was suddenly seized with eclampsia, and the mother in her fright mistaking the directions, gave thirty grains of bromide at one dose. Two hours afterward, when I was able to attend, I found that the convulsions had ceased at once, and that the patient was playful. Such cases show the innocuousness of a large dose of the bromide, and the safety in administering the medicinal dose often.

In severe cases the bromide does not always act with sufficient promptness and power. The hydrate of chloral should then be employed, given by the mouth or dissolved in two or three drachms of water, and given with a small glass or gutta-percha syringe per rectum. If used in sufficient quantity *per rectum*, and retained by pressure with a napkin, it is quickly absorbed, and will usually, in about fifteen or twenty minutes, control the movements. For a child of one year I employ about two grains, and for one of four years four grains, given by the mouth, or double this quantity given per rectum. With the use of the measures indicated above, eclampsia is, in my practice, much more amenable to treatment than in former years. Unless the cause be such that recovery is impossible from the very nature of the case, the convulsions will soon cease with these measures. It is interesting to observe the effect of the chloral enema. In from five to ten minutes the convulsive movements cease in the muscles of the face, a moment later in those of the arms, and lastly in those of the lower extremities.

But additional treatment may be required, according to the pathological state which has brought on the eclampsia. If it be an eruptive fever, as scarlatina, and the eruption have receded, active revulsive measures, as hot mustard baths, are required; if in dysentery, or other internal inflammation, the flaxseed and mustard poultice should be applied over the parts affected.

In those dangerous cases in which symptoms of cerebral congestion

continue after the eclampsia ceases, additional treatment is required. The child remains drowsy, does not speak, or apparently suffer in any way, and the pupils act less readily than in health. If this condition remain after the lapse of a few hours, there is probably serous effusion. All attacks of eclampsia, unless the mildest, are followed by a period of drowsiness, but the persistence of it, with symptoms which indicate hyperæmia, with perhaps effusion within the cranium, calls for the employment of additional measures. Vesication by cantharidal collodion should then be produced behind the ears, mild revulsives be applied to the extremities, the head kept cool, the bowels open, and, in certain cases, a diuretic like iodide of potassium may be advantageously employed. The utmost care should be enjoined in reference to the hygienic management of those who are subject to eclampsia. The diet should be nutritious, but bland, and all causes of excitement be studiously avoided.

CHAPTER XII.

TETANUS INFANTUM.

Tetanus or trismus is one of the most interesting diseases of infancy. It is first, in point of time, in the long catalogue of fatal maladies. It occurs suddenly and unexpectedly in the robust as well as feeble, almost certainly destroying life within a few hours under modes of treatment heretofore employed. It is more frequent in some localities and conditions of life than in others. In New York it is more common than tetanus at any other age, or, indeed, in all other ages, since the mortuary statistics of this city exhibit a larger number of deaths from this disease in the first year of life than subsequently. Infantile tetanus occurs, with very few exceptions, in the newborn.

Interesting and important as is tetanus infantum, it must be confessed that our knowledge of it is much more limited and imperfect than it should be, when we consider what great advancement has been made in pathological inquiries during the present century. Our information in reference to its causation, symptoms, and proper treatment is not much in advance of that of M. Dazille, or Dr. Joseph Clarke, who lived in the latter part of the last century.

Did we better understand the pathology of diseases in the newborn, or could we more accurately ascertain the condition of organs at this age, doubtless we should occasionally consider those phenomena which we now designate as a disease *per se*, under the title tetanus, as symptoms of some other affection. But as tetanic rigidity and spasms in the newborn occur so abruptly, masking all other symptoms, and ordinarily ending in death, without our knowing certainly whether or not there is any antecedent disease, it seems proper that we should

recognize the state in which such muscular rigidity occurs with such a rapid result as an independent affection. This explanation is required from the fact that I have added to the accompanying table one case from Billard, which this observer relates under the head of spinal meningitis. In this case, an infant three days old was attacked with convulsions. "His limbs were rigid and violently bent; the muscles of the face were in a continual state of contraction." On the following day "the convulsions continued; . . . the body remained rigid, and the vertebral column, which the weight of the trunk will cause to bend with the greatest ease in a young infant, remained straight and immovable whenever the child was raised." At the autopsy, in addition to meningeal apoplexy, which is often present in those who die of tetanus infantum, a thick pellicular exudation was found upon the spinal arachnoid. There is, therefore, a strict accordance of the symptoms and history of this case with those which other observers describe as examples of tetanus infantum; moreover, as a satisfactory reason for including this case in our statistics, certain observers, as we shall see, have reported epidemics of tetanus in which meningitis was the principal lesion.

Fatal Cases.

Case 1. Male; taken when three days old; lived sixty hours. Labatt, *Edin. Med. and Surg. Jour.*, April, 1819.
" 2. Female; taken when three days old; lived forty hours. *Ibid.*
" 3. Taken when five days old; lived fifty hours. *Ibid.*
" 4. Taken when three days old; lived one day. *Ibid.*
" 5. Male; taken when two days old; lived two days. Billard, *Treatise on Diseases of Children*, Stewart's trans., p. 477.
" 6. Male; taken when three days old; lived two days. Romberg.
" 7. Male; taken when six days old; lived ninety-three hours. Dr. Imlach, *Month. Jour. of Med. Sci.*, Aug. 1850.
" 8. Female; taken at five days; lived four days. Caleb Woodworth, M.D., *Boston Med. and Surg. Jour.*, Dec. 13, 1831.
" 9. Negro; taken at seven days; lived twenty-four hours. P. C. Gaillard, M.D., *South. Jour. of Med. and Phar.*, Sept. 1846.
" 10. Male; taken when seven days old; lived one day. Augustus Eberle, M.D., *Missouri Med. and Surg. Jour.*, 1847.
" 11. Taken when seven days old. D. B. Nailer, *N. O. Med. Jour.*, Nov. 1846.
" 12. Male; taken when three days old; lived one day. *N. O. Med. and Surg. Jour.*, May, 1853.
" 13. Negro; taken when three days old; lived three days. Robert H. Chinn, M.D., *N. O. Med. and Surg. Jour.*
" 14. Taken when two days old; died in four hours after the doctor's visit. *Ibid.*
" 15. Taken when seven days old; lived one day. C. H. Cleaveland, *New Jersey Med. Rep.*, April, 1852.
" 16. Negro; taken when seven days old; death finally. Greenville Dowell, *Amer. Jour. of Med. and Sci.*, Jan. 1863.
" 17. Taken when twelve days old; lived one day, Thomas C. Boswell, communicated to Dr. Sims, *Amer. Jour. of Med. Sci.*, 1846.

Case 18. Taken when about five days old; died at about the age of nine days. B. R. Jones. *Ibid.*
" 19. Taken at or soon after birth; lived two days. Dr. Sims, *Amer. Jour. of Med. Sci.*, April, 1846.
" 20. Taken at the age of six days; lived one day. *Ibid.*
" 21. Taken when three days old; lived two days. *Ibid.*
" 22. Male; taken at the age of eight days; died in three hours. Communicated to the writer.
" 23. Taken at the age of twelve hours; lived two days. Communicated to the writer.
" 24. Female; taken when seven days old; lived forty-five hours. The writer.
" 25. Male; taken at the age of seven days; lived about forty-eight hours. *Ibid.*
" 26. Female; taken at the age of eight days; lived three days. *Ibid.*
" 27. Female; taken at the age of five days; lived three days. *Ibid.*
" 28. Female; taken when four days old; lived two days. *Ibid.*
" 29. Taken when six days old; died next day. *Ibid.*
" 30. Taken when five days old; lived twenty-four hours. *Ibid.*
" 31. Taken when eight days old; lived two days. *Ibid.*
" 32. Male; taken when five days old; lived one day. *Ibid.*

Favorable Cases.

Case 1. Negro; female; taken when three days old; recovered in a few days. Robert S. Baily, *Charleston Med. Jour. and Rev.*, Nov. 1848.
" 2. Negro; taken at eleven days; recovered in fifteen days. W. B. Lindsay, *N. O. Med. Jour.*, Sept. 1846.
" 3. Negro; taken when ten days old; recovered in thirty-one days. P. C. Gaillard, *Charleston Med. Jour. and Rev.*, Nov. 1853.
" 4. Male; taken at the age of eight days; recovered in twenty-eight days. *Ibid.*
" 5. Negro; taken at seven days; recovered in fifteen days. Augustus Eberle, *Missouri Med. and Surg. Jour.*, 1847.
" 6. Taken when eight days old; recovered in four weeks. Furlong, *Edin. Med. and Surg. Jour.*, Jan. 1830.
" 7. Taken at the age of one week; recovered in two days. Dr. Sims, *Amer. Jour. of Med. Sci.*, April, 1846.
" 8. Female; taken at the age of three days; recovered in five weeks. The writer.

Period of Commencement.—Finckh,[1] who saw cases of tetanus of the newborn in the Stuttgart Hospital, states that it began in one case on the second day after birth, in eight on the fifth, and in seven on the seventh.

Professor Cederschjold, of Stockholm, treated forty-two cases in hospital practice in 1834, and in these cases it usually commenced between the ages of four and six days. Copland[2] says that it generally commences in the first seven or nine days after birth, and rarely later than the fourteenth. Romberg states that it commences between the fifth and ninth days. In two hundred cases observed by Reicke, in Stutt-

[1] Hecker's Annalen, vol. iii., No. 3, p. 304. [2] Medical Dictionary.

gart, in the course of forty-two years, it was never found to commence before the fifth, rarely after the ninth, and never after the eleventh day, Schneider says that the disease occurs oftenest between the second and seventh, and rarely after the ninth day. In six cases reported by Dr. C. Levy, of Copenhagen, it began in two on the third day, in two on the fifth, and in two on the sixth. Dr. Greenville Dowell, who has seen much of tetanus infantum among the negroes in Mississippi and Texas, says it is almost sure to come on between the fifth and twelfth days after birth. In the forty cases embraced in the above table, the disease began as follows:

Age.	Cases.
Under two days	2
Two days	1
Three days	9
Four days	2
Five days	6
Six days	3
Seven days	8
Eight days	6
Ten days	1
Eleven days	1
Twelve days	1

Very rarely, as will be seen hereafter, tetanus begins at or so soon after birth, that it may properly be called congenital.

Frequency in Certain Localities.—Tetanus infantum occurs probably in all countries, but it does not greatly increase the mortality except in certain localities. Some of the British and Continental physicians, whose observations of disease have been ample, confess that they have seen so few cases that they have almost no personal knowledge of this malady. On the other hand, there are, or have been, places in every zone where it is or has been so prevalent as to check sensibly the increase of population. The attention of the profession, more than a half century since, was directed to the prevalence of tetanus in the Island of Heimacy, off the coast of Iceland. On this island scarcely an infant escaped, while on the mainland scarcely one was affected. Heimacy, the product of volcanic action, of small extent and almost destitute of vegetation, supports a scanty population. The inhabitants live chiefly on the flesh and eggs of the sea-fowl, and are filthy and degraded in their habits. About the year 1810, the Danish government deputed the *landphysicus* of Iceland to visit Heimacy, and ascertain the nature of the disease which was so destructive to the infants. Although this gentleman, from his brief stay, saw no case himself, he obtained interesting particulars in reference to the disease from the priests and parents. At this time scarcely an infant escaped. Again, according to Dr. Schleisner, whose report in reference to the same locality was published forty years later, tetanus was still the most fatal of all infantile maladies.

Tetanus infantum is also represented as very fatal in the Island of St. Kilda, off the coast of Scotland. In the temperate regions of

[1] Amer. Jour. of Med. Sci., Jan. 1863.

America and Europe cases are not frequent, except occasionally in the poor quarters of cities, in foundling hospitals, and rarely in country towns where the conditions are favorable for its occurrence. The records of the Dublin, Stuttgart, and Stockholm lying-in asylums furnish many cases. In the town of Fulda, Germany, in 1802, Dr. Schneider saw six cases in fourteen days, while a midwife in the same place stated that she had seen more than sixty in nine years.

But the greatest mortality from tetanus infantum is in the warm climates, both of the Eastern and Western Hemispheres. In the West Indies, the southern portion of the United States, the equatorial regions of South America, and in the islands of Minorca and Bourbon, it has, in many localities, been the most frequent and fatal of infantile maladies.

It is an interesting fact that in the warm regions of the United States the victims are chiefly negro infants. L. S. Grier,[1] M.D., of Mississippi, says: "The first form of disease which assails the negro among us is trismus. The mortality from this disease alone is very great. No statistical record, we suppose, has ever been attempted, but from our individual experience we are almost willing to affirm that it decimates the African race upon our plantations within the first week of independent existence. We have known more than one instance in which, of the births for one year, one-half became the victims of this disease, and that, too, in spite of the utmost watchfulness and care on the part of both planter and physician. Other places are more fortunate, but all suffer more or less; and the planter who escapes a year without having to record a case of trismus nascentium may congratulate himself on being more favored than his neighbors, and prepare himself for his own allotment, which is surely and speedily to arrive." Dr. Wooten[2] says: "It is a disease of fatal frequency on the cotton plantations in this section of Alabama." He has, however, never seen a white child affected with it.

While tetanus infantum prevails in regions wide apart, and presenting very diverse climatic conditions, there is a similarity as regards the personal and domiciliary habits of the people who suffer most from its occurrence. It occurs chiefly among those who are filthy and degraded in their habits, who live, either from choice or necessity, in neglect of sanitary requirements. This fact aids us in an understanding of the—

Causes.—That uncleanliness and impure air are causes of tetanus is as fully demonstrated as most facts in the etiology of diseases. The attention of the profession was forcibly directed to this cause by Dr. Joseph Clarke in a paper read before the Royal Irish Academy in 1789. This physician was in charge of the Dublin Lying-in Asylum, and had rightly concluded that the mortality among the newborn infants was due to imperfect ventilation. Through his advice, apertures, twenty-four inches by six, were made in the ceiling of each ward; three holes, an inch in diameter, were bored in each window frame; the upper part of the doors leading into the gallery were also perforated with sixteen one-inch apertures, and the number of beds was reduced. The results of these simple sanitary regulations may be seen from Dr. Clarke's own

[1] N. O. Med. and Surg. Journ., May, 1854.
[2] Ibid., May, 1846.

statement. He says: "At the conclusion of the year 1782, of 17,650 infants born alive in the Lying-in Hospital of this city, 2944 had died within the first fortnight, that is, nearly every sixth child." The disease in nineteen cases out of twenty was tetanus. After the wards were better ventilated, namely, from 1782 till the time of the preparation of Dr. Clarke's paper, 8033 children were born in the hospital, and only 419 in all had died, or about one in nineteen. So impressed was Dr. Evory Kennedy, who at a later period had charge of the same asylum, with the belief that Dr. Clarke had discovered the true cause, and had been able in great measure to prevent it, that he enthusiastically writes: "If we except Dr. Jenner, I know of no physician who has so far benefited his species, making the actual calculation of human life saved the criterion of his improvements." The cases occurring in my own practice have almost all been in tenement-houses, where habits of cleanliness are not observed, and I have not yet seen, in the practice of others, nor heard of a case which occurred in the better class of domiciles. The statements of physicians in the Southern States, who speak from extensive observation among negroes, are strongly corroborative of the belief that the disease is in great measure due to uncleanliness and lack of pure air.

Dr. Greenville Dowell, of Texas, states that he has been able to trace tetanus infantum to the bedclothes, saturated with excrementitious matters, which are found in the negro cabins. In a paper published by Prof. John M. Watson,[1] the frequency of this disease among negroes is accounted for as follows:

"When called to see their children, we find their clothes wet around their hips, and often up to their armpits, with urine. . . . The child is thus presented to us, when, on examination, we find the umbilical dressings not only wet with urine, but soiled, likewise, with feces, freely giving off an offensive urinous and fecal odor, combined at times with a gangrenous fetor arising from the decomposition, not desiccation, of the cord."

Another cause is believed to be some irritation in the intestines, as from retained meconium. Observers in the Southern States and elsewhere occasionally mention this as a cause. In one case treated by myself, there was obstinate constipation immediately before the attack, and in another diarrhœa preceded, and was the only apparent cause.

In certain cases the assignable cause is exposure to wet or cold, or to a variable temperature, which, it is known, occasionally causes tetanus in the adult. Prof. Cederschjold attributed the epidemic which he observed in Stockholm to a sudden change of temperature from hot weather in May, to frosty in June. In a case related by Dr. P. C. Gaillard,[2] the disease commenced as follows: The nurse came in with wet apron and clothes, in the evening; a short time after she had taken the child into her lap, it sneezed violently two or three times. At 10 P. M. tetanus began. In certain localities on the continent, where there are no parish churches, the frequent occurrence of tetanus

[1] Nashville Journ. of Med. and Surg., June, 1851.
[2] Southern Jour. of Med. and Pharmacy, Sept. 1846.

has been attributed by physicians to the practice of carrying infants to a distance to be christened, thus exposing them to winds. In this city I have observed tetanus after a similar exposure. The influence of the weather in the production of tetanus of the newborn is also shown by facts observed in the Stuttgart Hospital. In an aggregate of twenty-five cases treated in that institution, all but three occurred in the cold months. In the Island of Cayenne, at a hamlet surrounded by mountains and dense forests, tetanus attacked only one in every twelve or fifteen of the infants. After a great part of the forests had been cut down, so as to allow access to the cold sea winds, almost all the newborn infants fell victims to tetanus. (*Insel, Cayenne.*)

Hein relates that a citizen of Berlin lost, successively, two children with tetanus soon after birth. When the second child fell ill he observed that its cradle was exposed to a current of air. At the third accouchement the position of the cradle was changed and the infant escaped. Exposure to wet and cold has been long recognized as a cause of the disease. According to Sauvages, "Hic morbus hieme et cum aurâ humidâ sæpius advenit quam sicca æstate."[1]

The causes of infantile tetanus enumerated above may be proximate or remote, may produce the disease by their direct effect on the system or indirectly by causing a pathological state which in turn leads to the development of the disease. There are other direct causes, namely, organic affections. In the bodies of the newborn who die of tetanus, lesions are observed which doubtless result from the spasms. Again, others are found which, from their nature, could not be a result, and which, being observed in different cases, are to be regarded as causes. The most frequent of such lesions is inflammation of the umbilicus or umbilical vessels.

Moschion, who lived in the first century of the Christian era, stated in writings still extant that stagnant blood in the umbilical vessels sometimes produced dangerous disease in the newborn infant, and it is supposed, though this is doubtful, that he referred to tetanus. In modern times the attention of the profession has been more particularly directed to this cause by a paper published by Dr. Colles.[2] The observations contained in this paper were made in the Dublin Lying-in Hospital during a period of five years. In each of these years he witnessed from three to five post-mortem examinations in cases of infantile tetanus, and the lesions, he states, were in all much alike, as follows: The floor of the umbilical fossa was lined by a membrane apparently formed by suppurative inflammation, and in the centre of this fossa was a large papilla. This papilla consisted of a soft yellow substance, apparently the product of inflammation, and in all the cases the umbilical vessels were in contact with this substance and were pervious. In a few instances superficial ulcerations were found near the mouth of the umbilical vein, and occasionally the skin surrounding the umbilicus was raised. The peritoneum covering the vein was highly vascular, often not to a greater distance than an inch above the umbili-

[1] Nosol. Method, vol. i. p. 531.
[2] Dublin Hospital Reports, vol. i., 1818.

cus, but sometimes as far as the fissure of the liver. The peritoneum in the course of the umbilical arteries presented the inflammatory appearance in still greater degree, sometimes as far as the sides of the bladder. The connective tissue lying along the arteries and urachus anteriorly was loaded with a yellow watery fluid. The inner surface of the umbilical vein was not inflamed, but its coats, in general, were thickened. On slitting open the arteries, a thick yellow fluid, resembling coagulable lymph, was found within their coats, and in all cases these vessels were thickened and hardened as far as the fundus of the bladder.

Dr. Finckh, who observed twenty-five cases in the Stuttgart Hospital, believes that the most frequent cause was suppuration or ulceration of the umbilical cord. In ten of the twenty-five cases the navel was dry and cicatrized; in the remainder it was either wet or swollen, with a bluish-red inflamed edge at the margin of the navel; a dirty viscid pus covered the umbilical depression.

Dr. Levy, physician of the Foundling Hospital in Copenhagen, attended twenty-two cases in that institution in 1838 and 1839. Of these twenty died, and fifteen were examined carefully after death. In fourteen there were decided marks of inflammation of the umbilical arteries, especially of those portions lying along the urinary bladder; in several cases the peritoneum over the arteries was much injected, and in three adherent either to the omentum or intestine by coagulable lymph; the coats of the arteries were thickened, their cavities dilated and containing dark reddish-brown or greenish puriform matter, always fetid. Sometimes the arterial tunica interna was found ulcerated and absent in places, and there was spongy thickening of the subjacent connective tissue. In two cases the ulcerative process had extended from the tunica interna to the peritoneum, and there was a deposit of thick ichorous matter around the ulcer; in one case both arteries were so softened that their coats were scarcely distinguishable, and in another these vessels had become gangrenous. The appearance of the umbilicus was unchanged in four cases; in ten the fundus was red and filled with puriform fluid, which quickly reappeared when removed, and, in general, shortly before death, the navel presented a greenish color.

According to Romberg, Dr. Schöller made post-mortem examinations in eighteen cases of tetanus infantum, and in fifteen found inflammation of the umbilical arteries. These vessels were swollen near the bladder, in one case to the diameter of four lines, and were found to contain pus. The lining membrane was eroded or covered with an albuminous exudation. Both arteries were not always equally inflamed, and in three cases only one was affected.

Schneeman[1] found minute points of suppuration in the umbilical vein in eight cases, and pus throughout the course of this vessel in one.

The observations mentioned above were made, for the most part, in hospitals on the Continent; but similar observations have been made in private practice. M. Borian,[2] of the Isle of Bourbon, says that he

[1] Holscher's Annalen, vol. v. p. 484, 1840.
[2] Gazette Médicale, Paris, July 11, 1841.

has found in every case inflammation around the umbilicus. Dr. John Furlonge,[1] who resided at St. John's, Antigua, attributes the disease to improper dressing of the umbilicus. The same opinion is expressed by Mr. Maxwell,[2] who also saw the disease in the West Indies. Dr. Ransom[3] states in a communication to Prof. John M. Watson, that he has never seen a case of tetanus of the newborn in which the umbilicus was healthy. In a case related by Robert S. Bailey,[4] there was a hard scab on one side of the umbilicus, and this part was much distended. A discharge followed the removal of the scab and the child recovered. In a favorable case, related by W. B. Lindsay[5] the umbilicus was tumid, and not disposed to heal. Dr. H. O. Wooten[6] attributes the disease to the condition of the umbilicus and umbilical vessels, and states that he has found the umbilicus gangrenous. A case has been reported in which the umbilical vessels were blocked up by purulent matter.[7] Robert H. Chinn,[8] M.D., of Brazoria, Texas, believes one cause of the disease to be improper tying and management of the umbilical cord, by which a diseased state is produced, which extends to the umbilicus and thence to the viscera. At a meeting of the Obstetrical Society of Edinburgh, held April 24, 1850, Dr. Imlach related a case in which there was a dark and gangrenous appearance on the integument around the umbilicus, and the peritoneum underneath was also dark but not inflamed; umbilical vein healthy; a little fibrin in the left umbilical artery; right umbilical artery much diseased; its two inner coats apparently destroyed, and in their place a yellow pultaceous slough, in which pus-globules were discovered with the microscope.

It is evident that the pathological state of the umbilicus and umbilical vessels described above, and which has been noticed by so many observers in different countries, cannot result from the tetanus. It is possible that the puriform substance noticed in the umbilical vessels was disintegrated fibrin, which had coagulated at the time of ligation of the cord, and the cells seen by Dr. Imlach and others may sometimes have been white corpuscles still remaining from the stagnated blood.[9] Still the evidences of inflammation, in at least a part of the cases related above, were of a positive character.

The belief that umbilical lesions occasionally cause tetanus infantum comports with the well-known traumatic causation of tetanus in the adult. This belief is strengthened by the fact, which will appear further on in our remarks, that tetanus of the newborn, from being frequent in certain localities, has become infrequent through greater care in dressing and managing the umbilical cord.

But there are cases of tetanus infantum in which there is no disease in or about the umbilicus. Dr. Finckh, of Stuttgart, examined the umbilical vessels in eleven cases without discovering any pathological

[1] Edin. Med. and Surg. Journ., Jan. 1830.
[2] Jamaica Phys. Journ., copied into the London Lancet, April 11, 1855.
[3] Nashville Journ., of Med. and Surg., June, 1851.
[4] Charleston Med. Journ. and Rev., Nov. 1848.
[5] N. O. Med. and Surg. Journ., Sept. 1846.
[6] Ibid., May, 1846.
[7] Ibid., May 1, 1853.
[8] Ibid., Sept. 1854.
[9] Virchow's Cellul. Pathol.

change. Dr. Samuel B. Labatt,[1] master of the Dublin Lying-in Hospital, published a paper entitled "An Inquiry into an Alleged Connection between Trismus Nascentium and certain Diseased Appearances in the Umbilicus." This paper was designed as a reply to the essay of Dr. Colles. Dr. Labatt relates several cases in which there was no disease of the umbilicus and umbilical vessels, and others in which the disease was so slight that it probably produced no injurious effect on the health of the child. Dr. James Thompson,[2] who spent considerable time in the tropical regions, says: "I have myself examined nearly forty cases of infants that have sunk under this complaint. In many I have looked at no other part but the navel, and have found it in all states; sometimes perfectly healed, especially if the infants had lived several days; at other times a simple clean wound. When death occurred on the fifth or sixth day, the wound was frequently in a raw state. I never yet saw it in a sphacelated condition." This writer concludes from his observations that there are cases in which the cause is located elsewhere than in the umbilicus or umbilical vessels. Dr. John Breen[3] remarks: "From dissections . . . we have never been able to discover any peculiar morbid appearance which would justify us in offering any explanation of the pathology of the disease." In my own cases there was no evidence of disease of the umbilicus or umbilical vessels so far as could be ascertained by external examination, and in one (No. 32) a careful post-mortem examination disclosed no lesion of these parts.

The inference from the above observations is that, although umbilical disease may be an occasional, probably not infrequent, cause of tetanus infantum, cases occur in which such disease is not present, and we must look for the cause elsewhere. From the nature of tetanus infantum, the cerebro-spinal axis has been from time to time examined in those who have died of this malady, and occasionally sufficient cause has been found in this part of the system.

I have alluded in another connection to a case from Billard, in which tetanic rigidity occurred in an infant three days old, as the result of spinal meningitis. That tonic spasms not infrequently occur in older children in consequence of meningeal inflammation is well known, and in some of the reported epidemics of infantile tetanus meningitis was really present, and was doubtless the cause of the tonic spasms. Such an epidemic was observed by Professor Cederschjold in Stockholm, in 1834. Within a few months he treated forty-two cases, and, in addition to the lesions which are known to result from tetanus, there was found in the bodies examined a plastic exudation at the base of the brain. Finckh, of Stuttgart, made twenty post-mortem examinations of those who had died of this disease, and in nine found spinal meningeal inflammation.

Meningitis in the newborn is, however, rare, and we must regard it as an exceptional cause of tetanus.

[1] Edin. Med. and Surg. Journ., April, 1819.
[2] Ibid., Jan. 1822.
[3] Dub. Journ. of Med. and Chem. Sci., Jan. 1836.

In 1846 there appeared from the pen of Dr. Sims, then practising at Montgomery, Alabama, a paper designed to show that tetanus of the newborn is produced by pressure exerted on the nervous centre, through depression of the occipital bone. In 1848 the same writer[1] published a paper, fully enunciating his theory as follows: "That trismus neonatorum is a disease of centric origin, depending on a mechanical pressure exerted on the medulla oblongata and its nerves; that this pressure is the result, most generally, of an inward displacement of the occipital bone, often very perceptible, but sometimes so slight as to be detected with difficulty; that this displaced condition of the occiput is one of the fixed physiological laws of the parturient state; that when it persists for any length of time after birth it becomes a pathological condition, capable of producing all the symptoms characterizing trismus neonatorum, which are instantly relieved simply by rectifying this abnormal displacement, and thereby removing pressure from the base of the brain." In both papers cases are narrated in support of this theory, but there are serious objections to this mode of explaining the occurrence of the disease. In the first place, if this explanation were correct, tetanus ought ordinarily to occur sooner, for the occiput is as much depressed posteriorly, and in the majority of cases more depressed at birth than at the period when it does actually commence. Pressure on the medulla would certainly be followed by immediate and marked symptoms, instead of an immunity for four or five days.

Again, well-known facts in reference to the causation of tetanus infantum conflict with Dr. Sims's theory, as, for example, epidemics of the disease, its prevalence in one locality and absence in another, although no particular attention be given to the position of the infant, the diminution of the number of cases by greater attention to cleanliness, of which there is abundant proof. Moreover, there are many reported cases of this disease at the commencement of which there was no perceptible displacement of the occipital bone.

The inequality of the cranial bones often observed in tetanus infantum should, in my opinion, be explained as follows: When the newborn infant becomes emaciated the volume of the brain is diminished, like that of the trunk or limbs, and the sinking of the occipital bone simply corresponds with the amount of waste in the cerebral substance. Whatever the disease in the young infant, if there be much emaciation, the parietal bones will usually be found more prominent than the occipital. Now, in fatal tetanus infantum emaciation is very rapid; those fleshy and plump, if the disease do not speedily end, become pinched and wrinkled. Viewed in this light, the occipital depression should be regarded as a result, and not a cause, of the tetanus.

Although we do not accept the theory which attributes tetanus infantum to occipital depression, there are a few cases on record in which it was apparently due to injury of the head received at birth. Dr. Sims has related one such case, that of a negro infant. The mistress, an observing lady, gave to Dr. Sims the following account of it: Its head was "mightily mashed. . . . The bones seemed to be loose. I

[1] Amer. Jour. of Med. Sci.

got it to take a little boiled milk on the first day; but it swallowed very little and very badly, for its jaws seemed to be locked. On the next day it took spasms and got stiff all over; its hands were shut up tight, and its arms were bent up so (she placed her forearms at right angles). Every time I touched it the spasm would get worse all over, screwing up its face till it was the ugliest thing in the world; and when the spasms wore off it looked as well as any other newborn baby. But then the stiffness never left it, and the spasms kept coming and going till it died." It lived two days.

It is evident, from the description given by the mistress, that this was a case of tetanus commencing at or so soon after birth that it seemed almost congenital. The apparent cause was injury of the head, occurring in consequence of protracted birth, the infant being resuscitated with difficulty after several minutes.

Dr. W. C. Sutton[1] published a similar case. The infant at birth was apparently dead, but was resuscitated so as to live eighteen hours in a state of tetanic rigidity. In cases in which tetanus begins at birth, doubtless, the cerebro-spinal axis is in some way affected; but in the absence of post-mortem examinations, the exact nature of the lesion is uncertain.

It is evident, therefore, that in this disease, as in eclampsia, the cause in different cases may be entirely distinct. Dr. James Johnson, many years ago, expressed his belief in the multiplicity of causes, and he had been a careful and intelligent observer in the West Indies.

The causes may be arranged in two groups, one external, the other internal. In the first group should be placed imperfect ventilation, personal and domiciliary uncleanliness, and atmospheric vicissitudes; in the second group, so far as ascertained, inflammation of the umbilicus and umbilical vessels, meningitis, and, rarely, injury of the cerebro-spinal axis during birth.

The lesions resulting from tetanus infantum pertain chiefly to the circulatory system. In the cases examined by Professor Cederschjold, of Stockholm, already alluded to, the meningeal and cerebral vessels, and those of the spinal cord, the cavities of the heart, and the large vessels connected with the heart, were distended with blood.

Finckh made post-mortem inspection of twenty cases in the Stuttgart Hospital, the bodies at death having been placed on their faces, in order to prevent any deceptive appearance from the gravitation of blood. In four he failed to detect any alteration in the spinal cord or its membranes, but in the remaining sixteen he found effusion of blood, in considerable quantity, the whole length of the spinal cord, between the bony walls and the dura mater. It should be stated, however, that spinal meningeal inflammation was present in nine of the sixteen, though the extravasation did not, probably, result from the inflammation, but from the tetanus. The blood in Finckh's cases was very dark, sometimes fluid, at other times coagulated. In one case no change was observed in the appearance of the brain or its membranes. In the remaining nineteen, more or less extravasated blood was found on the

[1] Nashville Jour. of Med. and Surg., April, 1853.

surface of the brain, or in its interior. The substance of the brain was healthy, as also its membranes, except the congestion. The only abnormal appearance observed in the thoracic and abdominal viscera was strong contraction of some portion of the intestinal tube in five cases. Dr. West says: "The most frequent post-mortem appearances in these cases"—referring to tetanus infantum—"and that which I found in the bodies of all the four children whom I observed, consist of effusion of blood, either fluid or coagulated, into the cellular tissue surrounding the theca of the cord. Conjoined with this there is generally a congested state of the vessels of the spinal arachnoid, and sometimes an effusion of blood or serum into its cavity. The signs of congestion about the head are less constant, though much oftener present than absent, and sometimes existing in an extreme degree; while in one instance I found not merely a highly congested state of the cerebral vessels, but also an effusion of blood, in considerable quantity, between the skull and dura mater, and also a slighter effusion into the arachnoid cavity." Dr. Weber, of Kiel, also placed on their faces infants who had died of tetanus, and, without exception, found injection of the capillaries of the cord and spinal meninges and extravasation of blood. M. Matuszynski, according to Bouchut, "has observed effusions of blood of variable quantity, in the cerebral pia mater, in the ventricles, and in the choroid plexuses, with considerable injection of the membranes of the brain. He has also seen serous infiltration beneath the arachnoid, and serous effusion into the ventricles, accompanied by a diminution of the consistence of the cerebral substance." In two cases examined by myself there was intense injection of the cerebral meninges and of the meninges of the upper part of the spine, but no extravasation was noticed. The spinal canal was not opened. In a third case, in which the spinal canal was opened, there was extravasation in addition to the congestion; this was especially observed along the spinal theca.

Dr. H. O. Wooten[1] states that he has made several post-mortem examinations, and has found the pathological appearances as uniform as in any other disease, as follows: "Engorgement of the substance of the brain, and of the meninges lining the base of the brain, the medulla oblongata, and spinal marrow; liver congested."

In a case related by Dr. Imlach before the Edin. Obst. Soc., April 24, 1850, the upper part of the lungs was healthy, the posterior portion congested, and containing many dark points; heart and liver healthy; small intestines of a light brown color; stomach and large intestines pallid; there had been umbilical hemorrhage.

Romberg states that he found in a child whose death occurred from this disease, such intense congestion of the veins and sinuses of the brain, that a slight touch, and the removal of the cranial bones, produced extravasation of the partly coagulated and partly fluid blood. Dr. Schöller, on the other hand, found extravasation of blood in the spinal canal in only one case in eighteen.

It is seen from the above observations, that tetanus of the infant is

[1] N. O. Med. and Surg. Jour., May, 1846.

ordinarily accompanied by great passive congestion, which is especially marked in the cerebro-spinal axis, and that frequently extravasations occur from the distended capillaries. The embarrassment of respiration and the retarded circulation of blood consequent on the tetanic rigidity, afford sufficient explanation of this state of the vessels.

Symptoms.—In many cases premonitory symptoms are absent, or are so slight as to escape notice. In some patients fretfulness precedes the attack, but no more than is often observed in those who continue in good health. The first symptom which alarms the parents, and shows the grave nature of the commencing disease, is inability to nurse, or evident pain and hesitation in nursing. Commencing with rigidity of the masseters, the disease gradually extends to the other voluntary muscles, and in the course of a few hours the muscles of the limbs, as well as of the trunk, are involved. Persistent muscular contraction, which is the pathognomonic feature of infantile tetanus, is developed not fully in the beginning, but by degrees in each affected muscle, so that it is not till after the lapse of several hours, perhaps even a day, that the greatest amount of rigidity is attained. Therefore, in the commencement of the disease, the limbs can be bent, and the jaw pressed open, more readily than at a subsequent stage, though with manifest pain to the infant.

During the period of maximum rigidity, the jaws are fixed almost immovably, often with a little interspace between them, against which the tongue presses, and in which frothy saliva collects. The head is thrown backward and held in a fixed position by the stiffness of the cervical muscles. The forearms are flexed; the thumbs are thrown across the palms of the hands, and are firmly clenched by the fingers; the thighs are drawn toward the trunk; the great toes are adducted, and the other toes flexed. Occasionally opisthotonos results from the extreme contraction of the dorsal and posterior cervical muscles. The infant can sometimes be raised without any yielding of the muscles, by one hand under the occiput and the other under the heels.

The rigidity is liable to variation in its intensity, even after the full development of the disease. If the infant be quiet, especially if asleep, the muscles are partially relaxed to such an extent sometimes, in the first stages of the complaint, that the features have a placid and natural expression, though only for a short time. Frequent exacerbations occur in the muscular contraction, sometimes without any apparent cause, and sometimes produced by anything which excites or disturbs the child. Attempts to open the lips or jaws, or eyelids, or to bend the limbs, blowing on the face, or even the crawling of a fly upon it, occasions the paroxysm.

During the paroxysm the eyelids are forcibly compressed, as well as the lips, which are either drawn in or are pouting; the forehead and cheeks are thrown into wrinkles, and the physiognomy is indicative of great suffering. The unnatural positions of the trunk and limbs, which result from the muscular contraction, are increased for the moment; the head is more forcibly thrown back, and the limbs more strongly flexed. The muscular movements which occur during the paroxysms are sometimes described as clonic spasms. There is indeed occasionally some

quivering of the limbs, and yet, as I have on different occasions noticed, so far from the muscular action being a clonic spasm, it is clearly tonic, and is intensified during the paroxysm. In fatal cases the paroxysms occur more and more frequently until the period of collapse.

The crying of the child affected by tetanus is never loud, however great the suffering. It is variously described by writers as "whimpering" or "whining." It is of this suppressed character in consequence of the rigid state of the respiratory muscles and their imperfect movement.

During the exacerbation respiration is suspended, or so imperfect, and the circulation so retarded, that the surface becomes of a deep red, almost livid, color. Sometimes epistaxis occurs, affording partial relief to the congestion, and sometimes, though less frequently, the blood forces itself from the congested liver along the umbilical vein, and escapes from the umbilicus. The intense passive congestion consequent on the tetanic spasm is general throughout the system, but extravasation of blood appears to be more common around the brain and spinal cord than elsewhere.

The frequency of the pulse and respiration varies in different cases, and at different stages of the same case. They are often somewhat accelerated, but at other times are natural, or are even slower than in health.

While the appetite of the infant, to appearance, is not diminished, the pain which it experiences in nursing is such that alimentation is necessarily deficient. It can be fed with a spoon for a time after it ceases to take food in the natural way, but artificial feeding soon fails. The milk placed in its mouth is in great part pressed back through the violence of the spasm which is induced by the attempt to feed it.

In consequence of imperfect nutrition, the infant rapidly wastes away. There is no other disease, except the diarrhœal affections, in which the emaciation is so rapid. In a case related by Dr. W. B. Lindsay,[1] the record states that "the infant was fat three days before, but was now emaciated." Romberg, who saw tetanus infantum in European hospitals, and Dr. Robert H. Chinn[2], of Texas, both speak of the rapid emaciation. The trunk and extremities lose their fulness, and the features become pinched. Several observers have noticed the appearance of miliaria in this reduced state of system, especially around the shoulders, and sometimes a decidedly icteric hue appears on the skin.

The condition of the intestines is not uniform. They may be relaxed, particularly if the disease be due to some irritation in them; in other cases the stools are natural or constipated.

It is often difficult to ascertain the state of the eyes, since attempts to open the eyelids bring on spasms and cause firm compression of the lids against each other. According to Sir Henry Holland, one of the first symptoms which occurred in cases on the island of Heimacy was strabismus, with rolling of the eyes. But this statement must be received with caution, since these cases were not seen by any physician,

[1] N. O. Med. Jour., Sept. 1846.
[2] N. O. Med. and Surg. Jour., Sept. 1854.

and the information was obtained from the parents and priests. If true, the proximate cause of the disease in Heimacy would seem to be located in the cerebro-spinal axis. Contraction of the pupils commonly occurs in the stage of collapse.

Mode of Death.—Death in infantile tetanus may occur from apnœa in the paroxysms, from extreme congestion of the cerebral vessels, or apoplexy; and, lastly, it may occur from exhaustion. The last mode is, probably, the most frequent.

Prognosis.—All writers till recently agree that tetanus of the infant rarely terminates favorably. Cullen attributes the ignorance of physicians in regard to this disease to the fact that it is so little amenable to treatment that they are not usually summoned to attend those affected with it. In the Island of Heimacy, of one hundred and eighty-five cases occurring during a series of years about the commencement of the present century, not one survived; and in the same locality, at Westmannoe, a small islet, sixty four per cent. of all the infants born died of trismus. (Report of Dr. Schleisner.) Similar statements in regard to the mortality of tetanus infantum are given by physicians in the Southern States. Dr. H. O. Wooten,[1] of Alabama, says that he has "never seen a decided case of tetanus nascentium that did not prove fatal, . . . and that it is very generally deemed useless to call in medical aid after the initiatory symptoms are well declared." Mr. Maxwell,[2] speaking in reference to the West Indies, says: "From observations which I have made for a series of years, . . . I found that the depopulating influence of trismus nascentium was not less than twenty-five per cent. It scarcely has a parallel within the bills of mortality." Dr. D. B. Nailer[3] says: "About two-thirds of the deaths among the negro children are from this disease, and so uniformly fatal is it, that a physician is never sent for."

Yet death does not always result. Eight of the forty cases in my collection recovered; but a correct opinion cannot be formed from this of the actual ratio of favorable to unfavorable cases, since favorable cases are much more likely to be published. In the history of these eight cases, two interesting facts are noticed, which, when present may serve as a ground for hope of a successful termination. These were, the age at which the disease began, and the fluctuation in the symptoms. With two exceptions, the infants who recovered were about a week old when the initiatory symptoms apppeared, and there were fluctuations in the gravity of the symptoms; whereas, fatal cases ordinarily grow progressively worse. Yet, in favorable cases, the symptoms are never so severe as they become in a few hours in those who succumb.

Duration in Fatal Cases.—Of eighteen cases observed by Finckh in the Stuttgart Hospital, fifteen died in two days, two in five days, and one in seven days. During the epidemic in the Stockholm hospitals, in 1834, where forty-two cases were treated, the disease seldom lasted more than two days. Romberg says: "It generally lasts from two to four

[1] N. O. Med Journ., May, 1846.
[2] Jamaica Phys. Journ., copied into the London Lancet, April 11, 1835.
[3] N. O. Med. Journ., Nov. 1846.

days, but its duration is at times limited at from eight to twenty-four hours, and occasionally, though rarely, it extends from five to nine days."

In thirty-one fatal cases in my collection, in which the duration is mentioned:

One lived	3 hours.
Eleven others lived	1 day or less.
Twelve lived	2 days.
Four lived.	3 days.
Three lived	4 days.

Both Underwood, who published a little treatise on diseases of children in 1789, and Dr. Elsässer, at a more recent date, record fatal cases which were unusually protracted. The one described by Underwood was treated in the British Lying-in Hospital, and, although all the others treated in this institution died by the third day, this lived six weeks; but it is suggested by the author that death was due in part to some other affection. The child treated by Elsässer lived thirty-one days.

Duration in Favorable Cases.—In the eight favorable cases in my collection, the duration of the disease, reckoned from the time when the infant ceased nursing till it began again, was as follows: In one case, two days; in one, a few days; in one, fourteen days; in two, fifteen days; in one, twenty-eight days; in one, twenty-one days; and in the remaining case, about five weeks.

Diagnosis.—To one who has seen this disease in the newborn, or is familiar with its symptoms, diagnosis is easy. The symptoms which possess diagnostic value are more manifest and reliable than in most other infantile maladies. Permanent rigidity of the voluntary muscles, with temporary exacerbations, such as have been described above, which are induced by any cause which disturbs the infant—as attempts to open the mouth or eyelids—is pathognomonic.

Preventive Treatment.—While tetanus infantum, if fully developed, is ordinarily fatal, in spite of any remedial measures heretofore used, there is no doubt of the efficacy and value of preventive measures, when properly employed. This was shown by the great reduction in mortality in the Dublin Lying-in Hospital through the thorough ventilation introduced by Dr. Clarke. Dr. Meriwether,[1] of Montgomery, Ala., says: "When the disease appears endemically on a plantation, it may be arrested by having the negro houses whitewashed with lime, inside and out; by raising the floors above the ground; by removing all filth from under and about the houses; by particular attention to cleanliness in the bedding and clothes of the mother; and in the dressing of the child, so as to prevent any of the matter from the umbilicus lying long in contact with the skin." Many physicians, especially in the Southern States, speak confidently of care in dressing the cord and attention to the umbilicus, as a means of prevention. Grafton[2] says that he has "never known the disease to occur in any child whose navel had the turpentine dressing." He uses turpentine as follows: "At the

[1] Amer. Journ. of Med. Sci., April, 1854.
[2] N. O. Med. and Surg. Journ., July, 1853.

first time, a few drops of undiluted turpentine are applied immediately to the umbilicus around the cord, and it is anointed at every succeeding dressing, the turpentine being diluted one-half or two-thirds with olive oil, lard, or fresh butter." This use of turpentine has also been recommended by other practitioners in warm regions.

Dr. John Furlonge,[1] of St. John's, Antigua, believes that no case would occur with the following treatment: "The cord, when divided, should be wrapped in clean linen. Every night, for two weeks, one or two drops of tinct. opii and spts. vini, equal parts, should be given, and castor oil, with a little magnesia, every morning. The child must be washed in tepid water every morning, and the funis dressed." If this treatment be attended by the success which is claimed for it by Dr. Furlonge, so great care in dressing the cord is certainly well repaid in localities, as at Antigua, where a large proportion of the infants die of tetanus.

Some experienced observers go so far as to assert that it is possible to ward off tetanus infantum after the occurrence of premonitory symptoms. Dr. Dowell[2] says: "Some, with slight twitchings of the muscles, have recovered without any trouble by being put into a mustard-bath washed clean, and put in a clean and well-ventilated cabin."

Treatment.—In considering the effect of medicinal agents which have been employed in the treatment of infantile tetanus, the great difficulty which the child experiences in swallowing should be borne in mind. Without care, a considerable part of the dose is lost by the spasm of the muscles of deglutition, which ordinarily occurs when the spoon is placed in the mouth, so that, unless special attention be given to this matter, it is uncertain whether the prescribed dose is fully administered.

The treatment employed by different physicians has been very diverse. Antiphlogistic remedies were prescribed by Finckh, but every case so treated was fatal. He states that whenever blood was abstracted, even in small quantities, the symptoms were aggravated. The same result has followed depletory measures in the practice of other physicians.

The internal remedies which have been most frequently prescribed are opiates and antispasmodics. Furlonge, in a favorable case, gave laudanum, in doses of one drop every three hours, alternately with two grains of Dover's powder. Woodworth also gave one-drop doses of laudanum; Eberle, one-sixth of a drop hourly. The opiate has generally been given in combination with an antispasmodic. The Dover's powder, given every three hours by Furlonge, was combined with five grains of sulphate of zinc. The hourly doses of laudanum, by Eberle, were combined with six drops of tincture of asafœtida.

When anæsthetics began to be employed in the treatment of diseases it was believed that they would be especially useful in cases of tetanus. Accordingly chloroform has been used in tetanus in the infant, with the effect of controlling the spasm during the time of its use, but with-

[1] Edin. Med. and Surg. Journ., Jan. 1830.
[2] Amer. Jour. of the Med. Sci., January, 1863.

out curing the disease. In Case 7 in our first table it was employed several times, but apparently without delaying the fatal result. The editor of the *New Orleans Medical and Surgical Journal* states, in the May issue of that periodical for 1853, that he has used chloroform in tetanus infantum, with the effect, he believes, of prolonging life. Anæsthetics certainly relieve the suffering of the infant, and on this account, even if they do not prolong life, their judicious employment seems proper.

The remedy which, in my opinion, is far preferable to all others, is hydrate of chloral. Since the introduction of this agent into therapeutics, it has been employed by several physicians in the treatment of this disease with so good a result that it will probably supersede all other medicines for this purpose. Dr. Widerhofer,[1] of Vienna, states that he has saved six out of ten or twelve by the use of chloral. He prescribes it in doses of one to two grains by the mouth, or, if there be great difficulty in swallowing, two or four grains by the rectum. Dr. F. Auchenthales[2] relates a case in which he gave even six-grain doses, and in nine days the disease had entirely disappeared. I have recently employed hydrate of chloral in a case of tetanus, giving it in half-grain doses, every two hours, except when there was profound sleep. The disease was fully developed, and the symptoms severe when I was called. I did not believe that the infant with the old remedies would live more than two days, but by the chloral life was prolonged nearly one week. Moreover, by the use of chloral the suffering of the infant is greatly diminished. The frequent inhalation of sulphuric ether also aids materially in controlling the spasms.

The administration of alcoholic stimulants is required at short intervals on account of the rapid emaciation and great prostration.

Local treatment directed to the umbilicus in those cases in which there is evidence of inflammation of the umbilicus or umbilical vessels should not be neglected. The application of an emollient poultice to the umbilicus has been followed by apparent improvement, if we may believe the statement of some physicians who have made use of this treatment. Dr. Meriwether, of Alabama, says, if there be no improvement from the medicine which he orders, he applies a blister, larger than a dollar, to the umbilicus, and with this treatment the child generally improves; a remarkable statement, since so few improve at all.

A warm foot-bath, repeated at intervals of a few hours, and stimulating embrocations along the spine, are proper adjuvants to the treatment.

[1] London Lancet, March 18, 1871. [2] Jahr. f. Kinderheil., N. S., iv.

CHAPTER XIII.

INTERNAL CONVULSIONS

(Spasm of the Glottis. Laryngismus Stridulus.)

Young children are liable to temporary suspension of respiration, induced by violent emotions, especially by anger. In the midst of their excitement, while they are crying or screaming, their breath is suddenly held, as if from tonic spasm of the respiratory muscles. In a few seconds respiration returns and is natural. There is no stridulous inspiration or other unusual sound, and there is no apparent ill-effect, unless occasionally a degree of languor. External convulsions, which seem to be threatening, seldom occur, and when they do, are ordinarily mild. Some writers consider dentition the predisposing cause of this arrest of respiration, by inducing a sensitive state of the nervous system. Such an effect of dentition is possible, but certainly many infants are affected in this manner before the age of dentition.

A much more serious state, and one which is recognized as a true disease, is that variously designated by writers as internal convulsions, spasm of the glottis, child-crowing, laryngismus stridulus, etc. Manifest difficulties attend the investigation of the pathological state in this disease. There can be little doubt that it is not precisely the same in all cases. That there is, during the paroxysms, tonic or clonic spasm of more or fewer of the respiratory muscles is inferred not only from the symptoms pertaining to the respiratory apparatus, but from the fact that in severe cases spasms of the external muscles, as those of the limbs and face, often occur. Usually, also, the movements of the eyeballs indicate spasmodic contractions of the motor muscles of the eyes. The fact of spasmodic muscular action in parts that are visible justifies the belief that it occurs in other parts which are concealed from view, especially as the characteristic symptoms cannot be readily explained except on this supposition. Trousseau says: "Internal convulsions consist, then, principally in a spasm of the diaphragm and of the respiratory muscles of the abdomen and chest; but it occurs, also, that the muscles pertaining to the larynx are affected with spasm at the same time with these." Rilliet and Barthez conclude from the symptoms that the "heart is not always a stranger to this internal convulsion, which, perhaps, prolongs itself even to the intestines." The muscles of the pharynx appear to be involved, in some cases, as well as those of respiration, rendering deglutition difficult. In one form of internal convulsions, namely, that which is principally referred to by writers, there is not complete arrest of respiration, but the inspirations, during the paroxysms, are difficult and are attended by a stridulous noise. Again the respiration may cease entirely, but when it commences it is stridulous, and difficult during

a few inspirations. In still another form of the disease respiration ceases, but there is no symptom or sign indicative of glottic spasm or of an obstacle to the ingress of air; the inspirations which succeed the paroxysm are easy and noiseless. It has been suggested that, in these cases, there is paralysis rather than spasmodic contraction of the respiratory muscles, but the symptoms may be explained in accordance with the commonly accepted opinion, namely, that there is spasm of the diaphragm and, perhaps, of certain muscles of the chest and abdomen, while the laryngeal muscles are not affected. M. Herard, indeed, who has written one of the best monographs on internal convulsions, describes three forms of the disease, according to the supposed location of the spasm, namely, laryngeal, diaphragmatic, and another, which consists of a blending of the two.

Internal convulsions are not frequent in this country; they are rare in France, more frequent in Germany, and quite common in Englandt They occur, with few exceptions, before the age of two years. Dr. Wes. observed thirty-one cases under the age of two years, and only six above that age.

Causes.—The causes of internal convulsions are not fully ascertained. Most observers have remarked the relative frequency of the disease during the period of dentition, and it is probable that dental evolution does operate as a cause, by rendering the nervous system more impressible.

Spasm of the glottis has been attributed to enlargement of the thymus gland, and also to enlargement of the cervical and bronchial glands. It is presumed that this effect is due to the pressure of these glands on the par vagum, or the recurrent laryngeal nerve. It is certain, however, that there is no such enlargement of the thymus gland which could possibly produce glottic spasm, or any other form of internal convulsion at the age at which these convulsions commonly occur. This gland is largest in the newborn, and having no function after birth, it gradually becomes atrophied. If an enlarged thymus could produce glottic spasm, it would certainly occur most frequently in the newborn. Abnormal development of the thymus gland seemed to be the cause of atelectasis in two infants who died soon after birth in my practice, but I have not seen a case in which a convulsive attack was referable to this cause. M. Herard examined the thymus gland in six children who died of internal convulsions, and in sixty who died of other affections, and was not able to discover in its condition any causative relation to this disease. Indeed, cases have been reported in which the thymus had undergone more than its usual atrophy at the time when the convulsions occurred (Hasse). Enlargements of the lymphatic glands in the vicinity of the pneumogastric or recurrent laryngeal nerve may possibly give rise to glottic spasm, but this is doubtless an infrequent cause, if it be a cause at all, since these glands are often greatly enlarged in strumous and tubercular diseases without such a result. According to Dr. Jacobi:[1] "In some cases, described by Dr. Friedleben, a congenital hypertrophy of the thyroid gland has probably been the cause of laryngismus. The patients were newborn infants of normal development, and born by normal labors.

[1] N. Y. Journ. of Med., Jan. 1860.

There were no constitutional causes of the disease, but a remarkable vascular swelling of the thyroid gland. Whenever the swelling increased, the veins of the face and head increased in size also, the face grew livid, and the extremities and spinal column exhibited slight tonic convulsions. The recurrent nerves were entirely surrounded by the glandular tissue, their neurilemma looked unusually red, and their functions were probably injured during the occasional swelling taking place during lifetime." (Jacobi.)

The cause is occasionally located in the cerebro-spinal axis. Thus Dr. Coley relates a case in which an exostosis arising from the internal surface of the occipital bone pressed upon the cerebellum, while nothing abnormal was discovered in other organs. Examples are also related in which the cause was located in the spinal cord. Thus Marshall Hall relates the case of a child with spina bifida, who was attacked with croup-like convulsions whenever it lay so as to press on the tumor.

Internal convulsions are also frequent in rachitic softening and absorption of the calvarium, since, when this is present, undue pressure occurs upon the brain, by the weight of the head of the child upon the pillow.

In some patients there is evidently an hereditary predisposition to this disease; those affected belonging to families in which a tendency to convulsive maladies is manifested. Thus Toogood states that five infants of the same family were affected with spasm of the glottis; and Reid relates, on the authority of Powel, that of thirteen infants of the same parents only one escaped internal convulsions.

The common predisposing cause is an excitable state of the nervous system, often associated with impaired general health. Hence the disease is more prevalent in cities, where antihygienic conditions abound, than in the country. Hence, too, the frequent improvement when the patient is removed to the pure and bracing air of the country. The use of insufficient food, or food of a bad quality, must for the same reason be considered a cause, since it leads to impoverishment of the blood, and renders the nervous system more impressible. Facts mentioned by Reid and others show conclusively the influence of premature weaning, and the use of indigestible or otherwise improper aliment, in the production of this disease.

The causes enumerated above are for the most part predisposing; occasionally they are the only apparent causes, since this disease sometimes occurs when the child is tranquil, even in the midst of quiet sleep, or when it is at rest in its mother's arms. In other cases and more frequently, there is an exciting cause, often trivial. Anything that requires exertion on the part of the infant, or that excites strong emotions, may be a direct cause, as anger, or any of the violent passions; so may even coughing, or, in rare instances, attempts to swallow. One author has known it to occur from excitement produced by examining the throat with a spoon. In a case in my practice, hereafter related, it occurred whenever the infant cried violently. It appears from the above facts that the etiology of internal convulsions is very similar to that of eclampsia. The same spasmodic muscular contraction may occur from a variety of causes.

Anatomical Characters.—While, therefore, structural changes in various parts of the system may give rise to internal convulsions, this disease, so far as ascertained, presents no anatomical characters, and must consequently be considered one of the neuroses. The lesions of the respiratory apparatus which are seen at post-mortem examinations, are due to the convulsions or are coincidences. Emphysema has sometimes been observed as a result, it is believed, of the spasmodic and irregular respiration. It was present in all of Herard's cases, and Rilliet and Barthez consider it common in those who die of this affection, although they did not observe it in any of their cases. Slight emphysema in the upper lobes is, however, a common lesion in feeble infants, whatever the diseases of which they die. Therefore its occurrence in internal convulsions is probably due more to molecular change in the lungs, since these patients are cachectic, than to the irregular breathing, which is only momentary.

In fatal cases of internal convulsions the blood is darker than usual, from an excess of carbonic acid; and in some cases the cavities of the heart and large vessels are engorged with blood; but in others they contain no more than the normal amount. More or less passive congestion occurs in the internal organs; and congestion of the cerebral vessels is in some patients so great that transudation of serum occurs.

Symptoms.—I have said that the symptoms vary according to the seat and function of the muscles which are affected. There is generally previous ill-health. The child is drooping, and is sometimes restless for days before the disease appears. Finally, if the muscles of the glottis become affected, the peculiar crowing sound is heard now and then during inspiration. It is observed especially when the child is crying or is agitated. It may be loud and well-defined from the first, but in most patients it comes on gradually, so that several days elapse before its full stridulous character is developed. The attacks are more frequent and severe at night, in or after the first sleep, than in daytime.

Under favorable hygienic conditions, the malady may pass off without becoming more serious. In other cases the paroxysms gradually increase in frequency and severity. The dyspnœa in the attack is such that the features are livid, the head forcibly retracted, and death seems imminent from apnœa. In these severe paroxysms respiration often ceases entirely for a moment. When the spasm ends, a deep stridulous inspiration occurs, after which the breathing is natural. I have stated also that internal convulsions are often associated with those, usually tonic, but sometimes clonic, of the external muscles. In the tonic form, the thumbs are flexed across the palms of the hands, and sometimes are grasped by the fingers; the great toes are adducted, and the other toes flexed. In severe cases, the hands, forearms, feet, and legs are also somewhat flexed and rigid. At first, the contraction of the external muscles is temporary, either corresponding with the internal spasm, or it is most intense at the time of the spasm, though commencing sooner and subsiding later. After a while, however, if the disease continue, the spasmodic action of the external muscles becomes more persistent. In severe cases, nearly every inspiration is accompanied by the wheezing sound, and the paroxysms of dyspnœa are excited

by trifling causes. Anything that suddenly disturbs the mind or body may bring on the attack, as anger, the impression of cold, or currents of air. Dr. West calls attention to the fact that an anasarcous condition is sometimes present, accompanied by albuminuria.

If the convulsions affect other muscles, as the diaphragm or the pectoral and abdominal muscles, which are concerned in the respiratory function, while those of the larynx escape, respiration is irregular, or even suspended for a moment, but the stridulous laryngeal sound is absent, as there is no obstacle in the larynx to the entrance of air. In this form of the disease, the infra-mammary region may be strongly retracted during the paroxysm from tonic contraction of the diaphragm. In severe paroxysms, whether the spasm be laryngeal or diaphragmatic, consciousness is nearly or quite lost, the features may be pallid, or, if respiration be suspended, may be more or less livid. Relaxation of the sphincters of the bowels and bladder, with involuntary evacuations, often occurs in this disease during the attack.

The duration of the paroxysm may be a quarter, a half, or even a whole minute. Total suspension of respiration for even half a minute involves danger. In mild cases there may be but few paroxysms, and they slight. In other instances they occur in a severe form, almost daily for several weeks or even months. In the following case the muscles of the larynx were apparently not involved. The patient was scrofulous, and has since had scrofulous periostitis, with necrosis and exfoliation of the surface of the tibia. At the time of the internal convulsions she had, as seen by the history, a scorbutic or hemorrhagic cachexia.

Case.—On the 28th of August, 1858, a German female infant, fourteen months old, nursing, and having eight teeth, was suddenly seized with clonic convulsions. Uniformly delicate and pallid, she had been in her usual health till the age of twelve months, when she had a single convulsive attack, and from that date had remained well till August 27th, when, without any premonitory symptom, she had a stool consisting of almost pure blood, black and offensive. On the morning of the 28th a similar evacuation occurred, and another in the afternoon immediately preceding the convulsion. Pulse 128, after the convulsion; surface cool and pallid; flesh soft, but no emaciation. Turpentine was prescribed in two drop doses every two hours, and laudanum in one and a half drop doses, repeated sufficiently often to insure quietude.

On the 29th the pulse was 152. At 1 P. M. she had a general convulsion, lasting about five minutes; in the evening she had an evacuation similar to those passed on the preceding day. The record for August 30th states: "Pulse from 150 to 160; up to this time has been playful, but is now drowsy, and, when disturbed, fretful; manifests no desire for solid food, as before her sickness, but still nurses; has taken up to this time thirty-two drops of turpentine. When she cries or frets, she has a spasmodic attack." This was the commencement of internal convulsions, with which this child was affected for several months. An opportunity was afforded of observing their character, for her excitement, when she was examined, was usually sufficient to produce them. After a succession of short expirations, respiration ceased; for a moment she was apparently

insensible; eyes closed; face pallid; no frothing at the mouth. The return of consciousness and respiration was without any laryngeal râle; and after the attack she seemed as well as before. No external convulsion and no evacuation of blood occurred after August 31st.

There was gradual improvement in her health, but she continued for many months pallid and irritable, and subject to attacks of internal convulsions. On the 11th of April, 1859, when twenty-two months old, she had another attack of general convulsions. The record made on that day is: "Has had internal convulsions (one or more paroxysms) almost every day since last August, brought on usually by crying, when she is corrected in any way, or her wishes are refused." Again, on December 1, 1859, it is stated: "Has grown considerably since the last record, and appears to have recovered, except that at long intervals the spasms still occur." She took a preparation of iron, but her recovery seemed to be due more to the growth and development of the body and to hygienic than therapeutic measures.

The general health in internal convulsions is more or less impaired, except in mild forms of the disease, in which the convulsive attacks soon cease. Pallor, or a sickly and cachectic aspect, irregular, usually constipated bowels, poor appetite, and moroseness or irritability of temper, are common symptoms of severe and protracted cases.

Diagnosis.—This disease is easily diagnosticated, unless when its symptoms are masked by those of external convulsions; it may then escape notice. Spasm of the glottis may be mistaken for spasmodic laryngitis, and *vice versâ*. In some of the published cases this mistake appears to have been made. Spasmodic laryngitis is, however, so different, not only in its nature, but in its clinical history, that a differential diagnosis is not difficult. It is an inflammatory disease, and is attended with febrile reaction and a sonorous cough; it commences at night after the first sleep, and from exposure to cold—particulars in regard to which it contrasts with true spasm of the glottis, which in complicated cases is not attended by any febrile symptoms.

Prognosis—Modes of Death.—Statistics show great mortality in this disease. Dr. Reid, in a monograph on "Infantile Laryngismus," states that of 289 cases which he collated, 115 died. Rilliet and Barthez met with one favorable case in nine unfavorable; and Herard, one in seven. If the paroxysms be mild, infrequent, and dependent on a cause which can be easily removed, recovery is probable with proper treatment. The cause may, however, be such, even when the spasm is mild, that the case is necessarily unfavorable: as when it is due to disease of the cerebro-spinal axis. We should not, however, in any case consider the patient entirely safe, since grave symptoms may suddenly arise, so as to change entirely the prognosis. Long and severe paroxysms, with lividity of face, and symptoms of suffocation, indicate an unfavorable result. The same should be predicted also if the infant gradually waste away, losing appetite and strength, especially if the face be pallid and the pulse feeble.

There are three modes of death in internal convulsions. The first is apnœa. The infant dies suffocated in the attack. Respiration is first arrested, and then the pulse ceases, and at the autopsy the lungs and

the cavities of the heart are found engorged with dark blood. Death may also result from the state of the brain. In such cases, passive congestion of the brain occurs from obstruction to the return of blood from this organ to the heart and lungs; and if this congestion be not soon relieved, serous effusion also occurs. Death results from the congestion, and consequent œdema or dropsy.

The third mode of death is from exhaustion. Repeated and severe attacks undermine the constitution; the infant gradually grows pallid and thin, and dies of inanition, or of some disease which this state induces.

Treatment.—The treatment of internal convulsions has varied according to the theories which physicians have held in reference to its cause. Glandular enlargement is no longer regarded as a common cause, and therefore treatment directed to its removal is less frequently prescribed than formerly. The causes of internal convulsions are in part very similar to those of eclampsia, and the remedies employed in the one affection are, in a measure, appropriate in the other. That dentition is sometimes a cause, is usually admitted; and two cases, one of which occurred in my practice, and the other was reported to me, appeared to show that it may have a causative relation. The effect of dentition is especially observed in weakly infants, when several dental follicles are undergoing active evolution. Thus, in one of the cases to which I refer, five teeth pierced the gums in the course of two weeks; after which no convulsive attack occurred. If, therefore, the gums are swollen, the propriety of scarification should be considered, especially if the convulsions be so severe as to endanger life.

In all cases of internal convulsions a careful examination should be made, in order to detect any aberration from the normal state which might cause nervous excitation. The condition of the digestive organs should be ascertained, and evacuants or other remedies prescribed if there be evidence of their derangement.

Sometimes the alimentation of the infant is at fault. It is, perhaps, bottle-fed, and the stools have an unhealthy appearance. Attention should be given to the preparation of its food and the times of its feeding; or, if it nurse, the mother or wet-nurse who suckles it, should have plain but nutritious diet, live with regularity, and give the breast to the infant at regular intervals. If there be a torpid state of the intestines, Dr. Meigs recommends "castor oil and aromatic syrup of rhubarb rubbed up together, three parts of the former and five of the latter." A simple enema answers well in such cases, and, in debilitated infants, this is preferable to medicine administered by the mouth. If diarrhœa be present, and it persist after the requisite changes are made in regard to the diet, remedies calculated to relieve it, which are mentioned elsewhere, should be employed. Marshall Hall states that he has ordinarily succeeded in curing the disease by attending to the condition of the gums and digestive organs.

Since rachitis is a not uncommon cause, the child should be examined in reference to the rachitic manifestations, and if they appear the treatment appropriate for rachitis is required.

In pallid and cachectic infants, tonics are indicated. The elixir of Calisaya bark with iron in half-teaspoonful doses, three or four times

daily, to an infant of one year, is an eligible preparation. The compound tincture of bark, or of gentian, or the two mixed, may be given instead of the Calisaya bark. The preparations of iron are frequently to be preferred to the vegetable tonics, as the citrate of iron and bismuth, citrate of iron and quinia, the syrup of iodide of iron, or the wine of iron. To an infant of one year the syrup may be given in doses of three drops, the citrates in one-grain doses, and the wine in doses of one teaspoonful, every four hours. If the child be old enough, it may take iron in lozenges, as those of chocolate and iron.

Antispasmodics, as asafœtida, valerian, and oxide of zinc, are often prescribed in this malady, but they are less efficacious than the general tonic measures which I have indicated. The salutary effect of bromide of potassium in eclampsia and epilepsy certainly justifies the trial of this agent in internal convulsions, if they persist after the employment of invigorating measures.

Hygienic measures are of the utmost importance. The infant should reside in dry and airy apartments, and should be kept much of the time through the day in the open air. Remarkable success sometimes attends this simple expedient, when medicines have entirely failed. Mr. Robertson,[1] of Manchester, relates five severe cases in which this malady was cured by exposure of the infants several hours daily to a cool atmosphere. These cases were treated in the winter months, and were kept outdoor, even during strong winds. Mr. Robertson has records of forty cases, all occurring between December and April, while he has seen no case in the summer months. As the result of such extensive experience, this writer recommends "the free exposure of the infant out of doors, for many hours daily, to a dry, cold atmosphere, and if the air be dry, the colder the better." Dr. Marshall Hall's experience was similar. Says he: "The curative influence of the air, and especially of the sea-breezes, is not less marked in this affection than in hooping-cough." Mr. Robertson recommends also, as part of the tonic treatment, "free sponging of the body every morning with cold water." In February, 1867, I attended a nursing infant, five months old, with internal convulsions, the paroxysms being attended with lividity of the face, and, at times, tonic convulsions of the limbs. Among the remedies employed was bromide of potassium, but more benefit obviously accrued from keeping the infant much of the time in the open air, than from the medicines employed. The disease passed off in six or eight weeks.

Unless the cause be of such nature that it cannot be removed, the above hygienic and therapeutic measures will, in a large proportion of cases, be followed by a satisfactory result.

The mother or nurse may abridge the paroxysm by raising the infant, blowing upon it, sprinkling water in the face, or gently stroking it. Dr. Hall recommends tickling the nostrils with a feather, to produce respiration, or the fauces, to occasion vomiting, and thereby interrupt the paroxysm. Anything which produces a sudden and profound effect upon the system may abridge the attack. This was effected in one case,

[1] London Med. Gazette, Jan. 14, 1865.

in the practice of Dr. C. D. Meigs, by applying a cloth wrapped around ice over the epigastrium and the lower part of the sternum. The chief danger during the attack is from congestion of the brain, with effusion of serum or extravasation of blood. If the attack be severe, and the features congested, so that there is evident danger of such a result, cold applications should be made to the head, derivatives used for the extremities—as sinapisms, or mustard foot-baths—and the bowels should be speedily opened by enemata.

CHAPTER XIV.

CHOREA.

CHOREA, or St. Vitus's or St. Guy's dance, is a neurosis, which is characterized by irregular and involuntary muscular movements, without loss of consciousness. The movements occur in the muscles of volition, and there is probably no one of them that may not be engaged, though some are more frequently affected than others. It is not known that any involuntary muscle is ever involved, though Sir William Jenner has expressed the opinion that occasionally the papillary muscles of the heart are, so that, by their spasmodic contractions, they produce insufficiency of the mitral valve. This, according to him, affords explanation of the fact that, in certain instances, a mitral regurgitant murmur is heard, which disappears about the time that the external movements cease. It is rare, however, that a mitral regurgitant murmur, heard during chorea, ceases when the latter terminates, and it is not improbable that in such cases there is, after all, a lesion of the valve, due to recent endocarditis, whether of a rheumatic or other origin. For a valve may be so thickened by recent inflammation as to cause a murmur, and after a few weeks or months the infiltrating substance be so absorbed that the murmur is no longer audible. If we admit the fact that cardiac bruits occasionally appear and disappear with chorea, this explanation seems to me more plausible than that of Jenner. Hillier says, in reference to this subject: "My own experience leads me to doubt the existence of dynamic apex murmurs in chorea, that is to say, murmurs produced in hearts entirely free from organic change. If such murmurs ever occur, they are certainly rare. Organic murmurs of the heart, on the other hand, are common in chorea, and I am inclined to believe that organic disease of the heart often exists in chorea when there is no murmur." We shall see that this opinion is correct, by a case presently to be related. Hillier also calls attention to the fact that choreic movements are irregular; but a cardiac bruit occurring regularly and uniformly, if not due to organic disease, would require rhythmical

contractions of the papillary muscles to produce it. We infer from this that the bruit does not have a choreic origin.

In the class of children's diseases in the Bureau for the Relief of the Outdoor Poor in New York City, 16,986 children were treated in the two years and three months ending with March 31, 1877. Of these cases 82, or one in every 207, had chorea. The patients were all under the age of fifteen years. Statistics published by observers in Europe show that the relative frequency of this disease is probably about the same in the large European cities as in New York. Thus, according to Hillier, amongst 122,621 out-patients treated at the Hospital for Sick Children, in London, 406, or 1 in 322, had chorea; while of the in-patients 174 in 5585, or 1 in every 32, were choreic. In the Parisian Hospital for Sick Children, of 84,968 admitted in twenty-one years, 531 had chorea, or 1 in every 161.

AGE.—Chorea may occur at any period of life, but a large majority of the cases are in childhood. It is rare in infancy, and it rarely begins after puberty. Under the age of five years the proportionate number diminishes, as we approach the time of birth. The youngest in the statistics of Hillier was three months. In 1870, in the Bureau for the Outdoor Poor a child was presented for treatment, who the mother said had had chorea from birth, and in 1877 I treated a young woman with severe general chorea, who, repeatedly questioned, uniformly said that she had had the disease, without any assignable cause, from the first week of her life, and her friends corroborated the statement. The following table exhibits the relative frequency of chorea at different ages:

	6 years and under.	6 to 10 years.	10 to 15 years.
Children's Hospital, London, Hillier, none over 12 years admitted	81	237	104
M. Rufz	10	61	118
Bureau for Outdoor Poor (prior to 1875)	2	26	16

	At and under 3 years.	3 to 5 years.	5 to 10 years.	10 to 15 years.
Bureau for Outdoor Poor (since January 1, 1875)	5	30	237	130

M. Sée collected the statistics of 531 cases occurring in the Children's Hospital, Paris, and from them concludes that the maximum frequency of chorea is between the sixth and tenth years. Only twenty-eight of his cases were under six years, the remainder, 503, occurring between the sixth year and puberty.

CAUSES.—The profession are nearly agreed in regard to certain causes of chorea, while there is a diversity of opinion in reference to others. It is admitted that in a large proportion of cases there is a neuropathic state, which antedates and predisposes to chorea. This state is often manifested in the family history by a proneness to affections of the nervous system, and in the individual by a highly excitable state of the emotions, so that he evinces joy, grief, or anger, from slight causes.

All writers admit that there is often an inherited predisposition to chorea. In 27 of 48 cases, Radcliffe found that father, mother, brother, or sister had been or was the subject of one or other of the following

disorders: paralysis, epilepsy, apoplexy, hysteria, or insanity. The children of parents who when young had chorea, or who exhibit proneness to ailments of the nervous system, are more liable to chorea than other children. Hence the fact sometimes observed, of different children in the same family becoming affected with chorea when they attain the age at which this disease ordinarily occurs. In one family in my practice, three girls at different times were affected.

Sex.—The emotions are strong in girls, since in them the nervous system predominates, while the muscular power is weaker than in boys. Hence a partial explanation of the fact which statistics fully establish, that the proportion of choreic boys to girls is about in the ratio of one to two and a fraction. I have remarked, in this city, the large proportion of cases in school-girls between the ages of six and twelve years; the severe discipline and confinement of the public schools no doubt increasing the strength of the emotions, and weakening the control of the will over the muscles.

Proportion of Males to Females.

27 to	73.	Hughes's Digest of Cases in Guy's Hospital, 1846.
138 to	393.	M. Sée.
50 to	94.	Outdoor Department, Bellevue.
276 to	499.	Children's Hospital, London West (Lumleian Lectures).
491 to	1059 = 1 to 2.15.	

The cases treated in the Outdoor Department, Bellevue, since those contained in the above table occurred, give a larger percentage of females. Between April, 1878, and December, 1883, 288 choreic cases were treated in this department, and of these the proportion of boys to girls was 1 to 2.4. (Chapin.)

Uterine Irritation.—The peculiar changes occurring in the female at puberty constitute an important cause. Hence another reason of the excess of female cases. Dysmenorrhœa and pregnancy are causes of a large proportion of cases in the first years of puberty. In the male, on the other hand, the changes of puberty do not appear to increase the liability to the disease, directly or indirectly, and male cases, after the age of twelve years, are comparatively rare. Radcliffe[1] states that after the ninth year, females are more liable to chorea than males, in the proportion of 5 to 2; while before the ninth year, the two sexes are equally liable to it. Carefully prepared statistics, however, notwithstanding the high authority of Radcliffe, show a preponderance of girls under the age of nine years, though not so great as over that age. In the Outdoor Department at Bellevue, of 35 patients under the age of ten years, 22 were girls, while of 20 from the age of ten years to sixteen 15 were girls.

According to West,[2] in 775 children with chorea, under the age of ten years, treated in the London Children's Hospital, 64 per cent. were girls.

Anæmia.—Among the most common predisposing causes of chorea is anæmia. It is present in so large a proportion of cases, exhibiting

[1] Reynolds's System of Medicine. [2] Lumleian Lectures.

itself by pallor of the countenance and other characteristic signs, that medicines designed to improve the quality of the blood are among the most valued remedies. The peculiar neuropathic state already alluded to, which needs only a slight additional cause for the development of chorea, is, no doubt, largely dependent on impoverishment of the blood, if it be not sometimes due entirely to it. Among the poor of a large city like New York, or in hospital practice, the proportion of anæmic cases of chorea is, for obvious reasons, much larger than would appear from the general statistics.

Rheumatism.—Dr. Copeland, M. Bouteille, and afterward M. Germain Sée, in a more extended monograph, directed the attention of the profession to rheumatism as a cause of chorea. Subsequent observations have established the fact that rheumatism, or the rheumatic diathesis, is so frequently present that it obviously sustains an important relation to chorea, though in what matter is not fully ascertained. This relation between the two is more frequently observed in some countries than in others. In England and France, so large a proportion of choreic patients present a history of rheumatism either in themselves or family, that certain physicians of these countries believe that rheumatism is the most common cause of the disease. In Germany, on the other hand, according to Romberg, in the majority of cases no relation can be traced between chorea and rheumatism. Probably the largest number of choreic cases treated in one institution in this country is in the Bureau for the Relief of the Outdoor Poor, in this city; and it has been our practice during the last few years to examine each patient for heart disease, and question the parents as regards rheumatism. Without referring to the exact statistics, I should say that more than half gave the history of rheumatism in themselves or parents, or had unequivocal signs of heart disease. One of the physicians of the class found that 22 in 38 consecutive cases of chorea gave the history of rheumatism or of heart disease in themselves or parents.

Various theories have been promulgated in explanation of the relationship of the rheumatic and choreic diseases. It has been suggested that chorea is due to rheumatism of the brain or spinal cord. This is simply an hypothesis, the truth or falsity of which can only be ascertained by carefully conducted necropsies; but the theory appears improbable in view of all the facts. Another theory attributes chorea to the state of the blood which is present in those having rheumatism or the rheumatic diathesis, as well as in certain other conditions. This theory is enunciated by Dr. Ogle, as follows: "Recognizing the frequent existence of these fibrinous deposits or granulations on the heart's valves in chorea, I should be much inclined to look upon these post-mortem appearances rather as results of some antecedent general condition of the blood, common also to the choreic condition. It is very freely recognized that this affection is frequently, in some way or other, connected with that condition of blood which obtains in what we call anæmia, or that existing in rheumatic constitutions. In both of these states we know that the fibrin of the blood is much in excess (as also it is in pregnancy, another condition looked upon as obnoxious to chorea): and in these states we know that the fibrin with which the blood is sur-

charged is very prone to be readily precipitated, either owing to its superabundance, or from other obscure and acquired properties . . . upon the heart's walls or valves. May not this hyperinosis be the explanation of the coincidence alluded to?"[1]—namely, the occurrence of chorea in those affected with rheumatism. Others still hold that chorea is the result of the heart disease, and not directly of rheumatism, occurring when the heart is affected from other causes, as well as when the lesion has a rheumatic origin. This theory is plausible, and probably to a certain extent correct. Heart lesions, observed in children, result from scarlet fever in a considerable proportion of cases, though it is true that the endocarditis and pericarditis of scarlet fever are believed often to have a rheumatic origin, occurring, in some instances, from scarlatinous rheumatism, but in other cases from scarlatinous uræmia. Occasionally, also, the heart disease appears to have occurred independently of both rheumatism and scarlet fever. Thus in a fatal case of chorea with valvular disease, related to the London Pathological Society, April 6, 1869, the child was always healthy up to the present illness (chorea), and there was no history of rheumatism in the family. The more observations accumulate, the more important does heart disease in itself appear as a cause of chorea. In nearly all recorded cases of fatal chorea, which were supposed to be due to rheumatism, and in which post-mortem examinations were made, endocardial and usually valvular disease has been found. We shall see that certain eccentric causes of irritation aid in producing chorea, and may not the valvular disease, or the endocarditis which causes the valvular lesion, operate in a similar manner as a cause? We know that in the adult severe cardiac disease often profoundly affects the nervous system, perhaps in consequence of the irregular and embarrassed circulation; and certainly in the child a similar cause would be likely to produce a more decided effect.

But there is an ingenious theory which attributes chorea to minute emboli detached from vegetations on the valves, and arrested by capillaries in the corpora striata, or other portion of the cerebro-spinal axis. Since attention was directed to this matter, emboli have been found in one case in the medulla oblongata, although this portion of the spinal axis appeared healthy to the naked eye. Further observations are necessary in order to determine how much truth there is in this theory; but it seems probable, for reasons to be stated, that if capillary embolism do cause chorea, it is only in a limited number of cases, and that therefore those British observers who regard it as the common cause, have been led into error by the large proportion of choreic cases which in their climate is complicated by valvular lesions.

That embolism is not a common cause, if indeed a cause at all, appears probable from the following facts: First. In many cases of chorea there are no vegetations, or other appreciable lesions, which could give rise to emboli. Secondly. Most patients recover, and some speedily, by treatment, which we would not expect if the cause were embolism. Thirdly. Embolism is not infrequent in the cerebral vessels of the adult, without the occurrence of chorea. Indeed, the conditions which produce embo-

[1] British and Foreign Med.-Chir. Rev., January, 1868.

lism are much more common in adults than in children, while the reverse is true as regards the liability to chorea. Fourthly. Dogs sometimes have chorea, but the injection of minutely divided fibrin or other substance into the veins of the dog is not followed by chorea as one of the phenomena. Fifthly. Were capillary emboli the cause, we would expect to find an occasional embolus in the larger vessels of the brain, so as to be appreciable to the naked eye; but I find no examples of this in all the recorded autopsies which I have been able to consult. Moreover, it seems improbable that capillary embolism, when producing no lesion appreciable to the naked eye, would so arrest the circulation, and disturb the function of the brain or spinal cord, as to cause chorea, for the ill-effects of such an obstruction would be likely to be obviated by the numerous anastomoses.

In 1877 the unusual opportunity occurred, in my asylum practice, of determining whether there are any fixed anatomical characters in the cerebro-spinal axis in chorea; in other words, whether chorea is a neurosis, as we have designated it in our definition, and the case is so interesting in other respects that I shall relate it entire.

Case.—Charles, a foundling, born Oct. 15, 1874, was received in the New York Foundling Asylum soon after his birth. When two weeks old he was removed to a family in the city to be wet-nursed. His health continued good till the age of three months, when he had bronchitis and keratitis, the former mild, and lasting only a few days, but the latter continuing nearly two months, being attended by moderate injection of the conjunctiva, with some purulent discharge, which caused adhesion of the eyelids during sleep. From this time he remained well, with the exception of a slight attack of dysentery, till the age of about nine and a half months, when he began to have febrile symptoms. In the morning hours he seemed in tolerable health, but at midday, or a little later than midday, of each day, he was observed to have slight irregularity or embarrassment of respiration, and lividity, with coolness of the extremities, which state, supposed at the time to be the algid stage of a somewhat irregular intermittent fever, lasted from one to two or three hours, and was succeeded by febrile movement, which continued during the remainder of the day; sometimes the fever abated in perspiration.

On August 4, 1875, a few days after the commencement of these irregular febrile symptoms, Charles was brought to the dispensary of the institution for treatment, and Dr. Reid, who was on duty that day, carefully examined the case, and prescribed the sulphate of quinia. This medicine continued a few days relieved the symptoms, but every four to six weeks, for more than a year, these febrile attacks returned, and were uniformly relieved by the same medicine. In other respects the patient had the usual health.

On or about February 1, 1878, the nurse noticed that Charles had what she designated "spells of trembling," in which he seemed excited and feverish, and which were sometimes attended by or followed by perspiration. In the course of another week the irregular muscular movements became more marked and constant, and they increased in severity till near the time of the admission of the patient into the asylum, about March 1st. The nurse had noticed in February slowness and some difficulty of micturition, and Dr. Reid examined him with a catheter for calculus, and also

his prepuce for any source of irritation, but nothing abnormal was discovered, either in the condition of the bladder or the external organs. In the latter part of April, the chorea had become so severe, that irregular muscular action occurred in all the limbs, and in the muscles of the eyes, producing such grimaces and contortions with strabismus, that the woman with whom he was boarding became alarmed, and returned him to the asylum, stating that he had become crazy.

On March 12th my attention was first called to this child, when I made the following entry in my note-book: Family history unknown; no history of rheumatism in patient's case, he may or may not have had it; heart sounds normal; pulse 104; all the limbs and the muscles of the face, eyes, and eyelids involved in choreic movements, which continue constantly except during sleep. The patient cannot walk or stand without support; appetite good, apparently better than in health, for he eats every kind of food handed to him, and carries the food with his own hand to his mouth, although these movements are very irregular and jerking. Three drops of Fowler's solution ordered after each meal.

March 17.—Condition not much changed, but perhaps slight improvement; in addition to other choreic movements the eyes twitch spasmodically; pulse 84; temperature 98½°; bowels regular; no cough; appetite good. Increase medicine to five drops.

30th.—The urine examined since the last record was found very pale and abundant; its specific gravity low, 1040, without albumen. When an equal quantity of nitric acid was added to it, after twelve hours crystals of nitrate of urea occupied about one-half of the volume of the urine. The patient's sleep is quiet, but the choreic movements recommence as soon as he awakens, but in a milder form; is able to walk without support, but with unsteady gait. My term of service ended March 31st. On the following day, laryngo-tracheitis was suddenly developed, ending fatally in forty-eight hours, at the age of two years five and a half months.

Autopsy, April 4th. Slight œdema about the aperture of the glottis; general and intense redness of mucous membrane of larynx, trachea, and bronchial tubes; as far as they can be traced, posterior portions of lungs greatly congested. The heart, lungs, brain, with one eye attached to it by optic nerve, and the entire spinal cord were sent to Prof. Francis Delafield, for microscopic examination. They were, as soon as removed, placed in a solution of bichromate of potassium. The following is a brief statement of the examination, which was made.

Microscopic Appearances. By Prof. Francis Delafield. *Brain*—presented no change apparent to the naked eye, except a considerable degree of congestion. It was hardened in bichromate of potassium and chromic acid. Minute examination of the convolutions of the brain, the large ganglia, the cerebellum, the pons Varolii, and the medulla oblongata showed nothing except a uniform filling of the vessels with blood, as if they were injected. There were no apoplexies, no changes in the walls of the vessels.

Spinal cord—appeared to be entirely normal.

The Heart.—The auricles and ventricles were of normal size. The aortic valves were atheromatous, and somewhat rigid; the mitral valves were thickened and insufficient; the endocardium of the left ventricle was thickened.

The Lungs.—The capillaries in the walls of the air-vesicles were dilated, and there was an increase of epithelial cells within the air-vesicles.

In this case there seemed to be no lesion associated with the chorea ex-

cept the organic disease of the heart, and the changes in the lungs secondary to this condition of the heart.

The above microscopic examination was made with sufficient minuteness, and it is seen that no emboli were discovered, and no lesion of the cerebro-spinal axis except congestion, which was attributable to the mode of death, namely, by obstructed respiration. Moreover it will be recollected that there were no cardiac *bruits*, and apparently not sufficient roughness of the edge or surface of the valves to cause precipitation of fibrin, which would be necessary in order that emboli should form.

Fright.—A not infrequent exciting cause of chorea is sudden and profound emotion, especially fright. All statistics give fright as the cause of a certain proportion of cases, though there are usually other potential coöperating causes, as anæmia or valvular disease. Fright was stated as the cause of chorea in 31 of the 100 cases occurring in Guy's Hospital, reported by Hughes, or nearly one in three. But the statistics of other observers do not give so large a proportion of cases originating in this way. Chorea may commence within a few hours after the fright, or not till the lapse of several days (eight or ten). If several weeks have passed since the fright, as in some reported cases, the chorea is probably due to other causes. In rare instances, chorea is said to have been caused by sudden and excessive joy.

Imitation.—Under unusual circumstances, especially in a state of great mental excitement, imitation has been known to cause a form of chorea. Hecker describes an epidemic of it, occurring in the middle ages, and spreading through villages. In modern times it is rare that chorea originates from this cause, nevertheless occasional examples have been recorded.

But the disease which occurs from imitation differs from the ordinary form, and has been termed chorea major; while the chorea which is the subject of this article is sometimes designated, in contradistinction, chorea minor.

In chorea major the patient leaps, dances, or whirls like a top. It has its origin commonly in religious excitement, and spreads by imitation almost in the manner of an infectious disease. The epidemic of the middle ages was a chorea major. I have not been able to find any account of cases spreading by imitation, in modern times, which were not examples of the same form of chorea. Thus in the *Edin. Jour. of Med. and Surg.*, for July, 1839, there is a clear description of chorea major occurring successively in five children in the same family. Dr. Dewar, the attending physician, states that one of the children whom he was called to see was sitting near the fireplace, when her head dropped on her chest, and she appeared to doze some minutes. In the meantime the respiration became a little accelerated, the face altered and flushed, the eyes wild. In less than one minute she bounded from one extremity of the apartment to the other, leaping over chairs, a chest, and then throwing herself upon the floor; she attempted to stand upon her head, rolled upon the floor, and then, rising, ran with extreme swiftness in the room, till she finally fell again upon the floor, where she remained motionless some minutes. Then, recovering, she noticed those

who surrounded her, and asked of her sister a toy, which she had allowed to fall. The whole paroxysm lasted twenty minutes.

Obviously, the symptoms of chorea major differ materially from those of chorea minor, and it is a question whether it should have the same generic name. It is a curious and interesting disease in its psychical and pathological aspects, but it is so rare in modern times that a knowledge of it is of little practical importance.

Intestinal Irritation.—In rare instances intestinal worms cause chorea, though in these cases there have usually been some coöperating causes. The following is an example related by Mr. Ogle[1]: "Ellen L., 9 years old, had been under treatment about a month with chorea, rheumatism, and worms. She had not slept in four days, and there was constant spasmodic movement of the body and face. Her general condition was very unpromising. As she had passed portions of a tapeworm at intervals during the last three months, one drachm of the oleum filicis maris was administered in mucilage, which caused the expulsion of the entire worm. From that time she fully and rapidly recovered from the chorea, though a mitral murmur remained."

Lesions of Brain and Spinal Cord.—Although we reject the theory that cerebral emboli are the common cause of chorea, and believe that in a large majority of cases there are no cerebro-spinal lesions, nevertheless experiments, and also occasional cases, establish the fact that if not true chorea, at least choreiform movements now and then result from a structural affection of the nervous centres.

Experiments on certain of the lower animals demonstrate that irregular muscular movements may be produced by traumatic injury of certain portions of the cerebro-spinal axis, as the corpora quadrigemina, crura cerebri, pons Varolii, crura cerebelli, thalami optici, parts of the medulla oblongata and the upper portion of the spinal cord. Pressure on the projecting part of the medulla oblongata of an acephalous monster also causes convulsive movements. At the meeting of the New York Academy of Medecine, April 20, 1871, Professor Post related the case of a child who was struck over the occiput with a billet of wood, and chorea followed, due, in all probability, to the injury of the brain which resulted.

If irregular muscular movements, choreic or choreiform, result from traumatic injury of certain portions of the nervous centres, may they not also occasionally occur from lesions of the same parts produced by disease? Sir Benjamin Brodie[2] relates the case of a choreic girl, dying in St. George's Hospital, in whom, after a careful post-mortem examination, the only morbid appearance observed was a tumor the size of a hazel-nut, connected with the pineal gland. Dr. Broadbent[3] described another case before the London Pathological Society, in which a tumor was found arising from the centre of the spinal cord; and Chambers one in which tubercles were embedded in the cord. Romberg quotes from Frerichs a case in which the medulla oblongata was pressed upon by an enlarged odontoid process; and Dr. Aitken[4] one in which the specific

[1] Lond. Medico-Chir. Rev., Jan. 1868.
[2] London Lancet, Dec. 19, 1840.
[3] Transactions London Pathological Society, vol. xiii. p. 246.
[4] Glasgow Medical Journal, vol. i.

gravity of the thalamus opticus and corpus striatum was greater on one side than on the other. Rilliet and Barthez relate other similar cases, and add: "We may conclude, from these different cases, that there exist two species of chorea: the one essentially a simple neurosis, while the other depends on an alteration of the encephalo-rachidian system. In a word, it is of chorea as of convulsions, that it is sometimes idiopathic, sometimes symptomatic." Still, the cases in which it is symptomatic are so few, that it is proper to consider chorea, as it ordinarily occurs, one of the neuroses until the microscope detects some anatomical cause in the cerebro-spinal system of which we are now ignorant.

Anatomical Characters.—We have seen that chorea has no constant anatomical characters. Lesions which probably sustain a causative relation to the disordered muscular action are sometimes present, and others are sometimes observed which are neither a cause nor result, their presence being a coincidence. But there are two lesions which, though often absent, have been observed in so large a proportion of fatal cases that they are justly regarded as an occasional result when chorea is severe. Dr. Hughes, of London, collected records of the post-mortem appearances of 14 cases, with the following result as regards the cerebro-spinal axis: Brain, 14 cases: healthy, 4 cases; only congested, 3 cases; softened in part or entirely, 6 cases (some of these 6 also congested). In some of the 14 cases those occasional results of congestion, to wit, transudation of serum and extravasation of blood, in greater or less quantity, were also observed. Spinal cord: healthy, 3 cases; congested, 2 cases (one slightly, in the other the engorged vessels were large and numerous); softening in medulla oblongata, 1 case; softening opposite fourth and fifth vertebræ, 12 cases. In one there was soft, in another firm adhesion of the spinal meninges, and in one it is stated that the rachidian fluid was opaque. Of sixteen fatal cases of chorea occurring in St. George's Hospital, "congestion (more or less complete) of the nervous centres (brain or spinal cord, or both) was met with in six cases." Softening of certain parts of the brain was observed in one case, and of the spinal cord in another.[1] Other statistics of the anatomical character of fatal chorea correspond, in the main, with those of Hughes and Ogle. The lesions observed by them are probably not present in ordinary cases, occurring only when the choreic movements are so severe that the patient is deprived of needed repose, and the important functions of the economy, as the circulation and nutrition, are seriously disturbed.

The post-mortem examination of other parts besides the cerebro-spinal axis furnishes a negative result, if we except such affections as have been ascertained to act as causes of chorea. What portion of the nervous centre is chiefly involved in chorea is uncertain. Some, as Sir Benjamin C. Brodie,[2] consider chorea a disease of the nervous system generally, while others have attributed it to disease or disorder of a certain part, as the corpus striatum, cerebellum, etc. Finally, it is stated that, in late experiments on choreic dogs, the movements do not

[1] Ogle, Brit. and For. Medico-Chir. Rev., Jan. 1868.
[2] London Lancet, Dec. 19, 1840.

cease when the spinal cord is severed from the brain, nor also on division of the posterior roots of the spinal nerves.[1] In these cases, therefore, the part of the axis which is in fault would appear to be solely the spinal cord.

Symptoms.—Chorea is partial or general. It is partial when it affects a few muscles, or groups of muscles, as those of one arm, the face or neck, or of one eye. It is designated general, when all the limbs, and certain of the muscles of the face and trunk, are involved. Statistics show that partial chorea occurs more frequently on the left than on the right side, and in general chorea the movements on the left side usually predominate. The commencement is, in most cases, gradual. Even when finally chorea becomes general, certain muscles only are affected in the commencement in ordinary cases. The child in whom this disease is about to begin is observed to be fretful and impatient from slight causes, and the irregular muscular action at first is apt to be misunderstood by the parents, who reprimand him for his supposed fidgety habit. In exceptional instances, especially when the cause is a sudden and profound emotion, the commencement is abrupt, and the disease is severe and general from the first.

In a majority of cases the muscles which are primarily affected are those of the face, neck, fingers, or hand on the left side. Sydenham erred, unless the clinical history of chorea has changed during the last two centuries, when he stated as the common fact that a tottering gait is its first manifestation; but now and then such a case does occur. Whenever choreic movements appear, other muscles besides those first affected are soon involved, so that in the course of a few weeks, sometimes of a few days, all the muscles that participate are engaged.

A muscle affected by chorea alternately contracts and relaxes, but less forcibly and rapidly than in eclampsia, and the movement is partly controlled by volition. This produces an unsteady and tremulous action of the part, whether a limb, the neck or face, which at once arrests attention, and indicates the nature of the disease. The result is similar, as regards the muscular action, whether the patient wills a movement, or attempts to control those which chorea produces.

If the case be of ordinary severity, the movements continue with but momentary intermissions, except during sleep, when they ordinarily cease. In grave cases patients are often deprived of the proper amount of sleep, in consequence of the severity and persistence of the muscular action, and in exceptional instances, especially when the result is fatal, the movements continue in sleep, but the sleep is not sound, and is frequently interrupted. In profound sleep, the muscles are always in repose.

The older writers have left us graphic descriptions of those diseases which have striking external manifestations, though often with somewhat of exaggeration. Sydenham says of chorea: "The patient cannot keep it (his hand) a moment in the same place; whether he lay it upon his breast, or any other part of his body, do what he may, it will be

[1] Legros et Onimus, Rech. sur les mouvements choreiformes du chien, Acad. des Sci., 9 Mai, 1870, Lyons Med. Jour., June 5, 1870.

jerked elsewhere convulsively. If any vessel filled with drink be put into his hand, before it reaches his mouth, he will exhibit a thousand gesticulations, like a mountebank. He holds the cup out straight, as if to move it to his mouth, but has his hand carried elsewhere by sudden jerks. Then, perhaps, he contrives to bring it to his mouth, and if so, he will drink the liquid off at a gulp, just as if he were trying to amuse the spectators by his antics!"

In severe general chorea a similar description is applicable to the movements of the legs and features. Grimaces and distortions of the features occur, while the gait is halting and unsteady, or it is impossible to walk, and the patient lies or sits. The speech is slow, thick, and indistinct, in consequence of the muscles of the tongue and larynx becoming engaged, and even mastication and deglutition are rendered difficult. The imperfect speech in chorea is attributed partly, however, to the mental state in severe protracted cases. Chorea, except when mild, is accompanied by other symptoms referable to the nervous system. More or less impairment of the mental faculties occurs in chronic cases when severe, exhibiting itself in dulness or apathy. The countenance sometimes presents in aggravated cases almost the appearance of idiocy. The muscles, instead of becoming hypertrophied and more powerful by their frequent contraction, grow softer, more flabby, and weaker. Indeed, a partial paralysis sometimes results, so that a degree of numbness is experienced in the affected part, and the limb when raised cannot be sustained. Pain is not a symptom of chorea, but fugitive rheumatic or neuralgic pains are sometimes experienced. Derangement of the digestive function, exhibited by a poor or capricious appetite, constipation, etc., are common.

In rare instances chorea affects the respiratory muscles so as to produce a peculiar involuntary barking or squeaking voice by the forcible expulsion of air over the tense vocal cords. In a case treated by Dr. L. C. Gray, in the N. Y. Polyclinic, the patient, a boy of fifteen years, had been choreic since his seventh year, and chorea in its usual form had continued one year when the barking sound commenced, and this has continued until the present time. Dr. French, of Brooklyn, also treated a similar case, having the following history: A boy of nine years, had choreic twitchings of the facial muscles at the age of five years. After continuing several months they ceased during an entire winter, after which the peculiar sound of the voice, resembling the squeak of a young turkey, commenced. It occurred at the beginning, middle, or end of respiration. It alternated with choreic movements of other parts of the system, so that when they ceased, it returned. By the laryngoscope, the irregular action of the vocal cords was observed, but the expiratory muscles of the chest were also involved, so as to produce the peculiar sound by the forcible expulsion of air. In Dr. French's case these vocal sounds ceased, except at rare intervals after three months of medicinal treatment.[1]

The urine of choreic patients has been examined by Drs. Walsh, Ford, Bence Jones, Handfield Jones, Radcliffe, and others, and its elements

[1] N. Y. Med. Record, Dec. 15, 1883, Dr. Chapin.

have been found in most cases to vary from their normal quantity. Dr. Handfield Jones[1] read a paper before the Clinical Society of London, in 1871, on two cases of chorea in which he had made careful chemical analysis of the urine, with the following result: During the height of the disease the amount of the urine was much in excess of what it was when the disease had ceased; the urea excreted during the choreic period was in excess, as was also the phosphoric acid excreted when the choreic symptoms were at their maximum, but the quantity of this acid was less than the average during convalescence; a moderate amount of uric acid during the disease was also observed, but none upon recovery.

Prognosis—Course.—Chorea, though obstinate and often incurable in adults, usually terminates favorably in children in two to four months. Bouchut considers its ordinary duration at from thirty to fifty days, which is certainly shorter than the average duration in this country, except when the disease is materially abridged by treatment. The same author states that it may continue only a few days, as he has observed in cases which occurred during convalescence from scarlet fever. But tremulousness of the muscles occurring in the state of weakness following a grave disease, and abating as the general health is restored, I should not consider as properly choreic, any more than that occurring from over-fatigue. As the choreic movements gradually increase in the initial period till a certain maximum is reached, so their decline is gradual. Temporary variations also occur throughout the disease as regards the extent of the movements, which are aggravated by mental excitement, bodily fatigue, certain functional derangements, especially of digestion, and sometimes from causes which are not apparent.

Though, as a rule, chorea in children ordinarily terminates favorably under different, and even injurious modes of treatment, there are exceptional cases. Romberg relates the history of a patient who died at the age of seventy-six years, having had chorea since the age of six years. In chorea limited to a few muscles, or a group of muscles, the prognosis is more doubtful than when it affects a large number, since in the former case the cause is more likely to be some lesion of the cerebro-spinal axis. Thus chorea involving only certain muscles of the neck or of the eyes is sometimes due to this cause, and is then very obstinate.

Again, observations demonstrate that chorea, when at first in all probability strictly a neurosis, but of a protracted and grave character, may give rise to a central organic disease. This is the course of most of the fatal cases, congestion, softening, or other lesion occurring over a greater or less extent of the nervous centres. Radcliffe has known cerebral meningitis to supervene in two instances. With the occurrence of a lesion of the cerebro-spinal axis new symptoms arise, such as headache, convulsions, delirium, and paralysis, and the choreic movements cease or continue, according to the nature of the lesion.

Chorea, like certain other diseases, either of a nervous character or having a nervous element, is more or less modified by intercurrent inflammatory and febrile affections. The oft-quoted expression from Hippocrates, *febris accedens solvit spasmos*, observations show to be founded

[1] London Lancet, July, 1871.

in fact, the most frequent example of which occurs in pertussis. In chorea the movements, as a rule, are either rendered milder or they cease as long as the febrile excitement continues; but there are exceptions, and the subsequent course of the disease is not modified.

DIAGNOSIS.—This is not difficult in ordinary cases. The irregular movements, with consciousness preserved, enable us to make a diagnosis at sight. In its commencement, and when it continues in an unusually mild form, chorea may be overlooked by the physician, as it often is by the parents, the movements being attributed to a fidgety habit: but medical advice is seldom sought till the movements are so pronounced that it is impossible to err, except through gross ignorance or carelessness.

It is important to determine when chorea merges in an organic disease, and also whether there is a local cause of the chorea. A careful and intelligent study of the symptoms and history of the case is requisite in order to a correct diagnosis in these particulars.

TREATMENT. *Regimenal.*—As chorea in a large proportion of cases occurs in a state of anæmia, and the vital forces are ordinarily more or less reduced, obviously the regimen should be such as invigorates the system. Fresh air and outdoor exercise, active or passive, according to circumstances, with the avoidance of undue excitement, are requisite, and the diet should be nutritious, but plain and unirritating. The various functions should be preserved so far as possible in their normal state. In exceptional instances, when the choreic movements are violent, the patient should lie in bed, and the muscular action, if so constant and excessive as to deprive him of the requisite sleep, should be restrained by light and well-padded splints.

Medicinal.—Sometimes among the coöperating causes is one of a local nature, which is susceptible of removal, as a carious and painful tooth, intestinal worms, etc., and measures calculated to effect this are obviously required. Allusion has already been made to a case in which the employment of the oleo-resina filicis and the expulsion of a tapeworm effected a speedy cure.

The remedy which has been most employed in chorea, and which in consequence of the anæmia is plainly indicated in a large proportion of cases, is iron. It does not interfere with the employment of other remedies which have a more specific effect. Nearly all the ferruginous preparations have been prescribed in different cases with benefit. Radcliffe gives the preference to the iodide of iron, believing that iodine, as well as iron, exerts a curative influence. I have of late inclined to the use of the ammonio-citrate, as it is easy of administration in simple syrup, and is well tolerated.

But iron must not be regarded as the main remedy, but rather as an adjuvant. Observations during the last few years in both continents have more and more established the claims of arsenic to be regarded as the most efficacious of all medicinal agents in the treatment of chorea. Properly administered, it abridges the duration of this disease more certainly than any other agent, and within a few days begins to modify the choreic movements in the severest cases. It is conveniently given in the form of Fowler's solution. It is better tolerated by children

than adults, and should be administered to them in a larger proportionate dose. A child of eight years can take five drops, diluted in water, three times daily after eating, and the dose may be increased if needed to eight, ten, twelve, or even fifteen drops. I have seldom observed any gastric irritability or other unpleasant effect from its use when it is administered largely diluted and after the meals, but if such occur, it should, of course, be suspended for a time.

While not hesitating to recommend iron and arsenic as superior to all other medicines in the treatment of chorea, it is not proper to ignore the opinions of other members of our profession, who have had ample experience and recommend other agents instead.

Trousseau gave the preference to strychnine, increasing the doses in some cases until it began to produce its poisonous effects.

Professor Hammond[1] says: "My main reliance is on strychnia, which, I think, should be given in gradually increasing doses, somewhat after the manner recommended by Trousseau. . . . This plan of treatment certainly shortens the duration of the disease very materially, and causes great improvement in the general health of the patient. Sometimes the effect is so well marked, and is so immediate, that it is not necessary to increase the doses to the extent of causing muscular cramps, but generally the full therapeutical effect of the drug is not obtained till the calf of the leg or the nucha has slight tonic spasm. I have never seen the slightest ill-consequence follow this mode of treatment, and the doses are increased so gradually that with careful watching danger need not be apprehended." Dr. Hammond has treated thirty-two children with this agent without a single failure.

But as chorea terminates favorably with smaller and safe doses, even if the time required be longer, it does not seem proper to recommend its employment to the extent of producing physiological effects for general practice. Bouchut, speaking upon this point, says: "But, with these precautions, strychnia is extremely dangerous, for I have seen, at the Hôpital des Enfants Malades, a young girl of thirteen years die in tetanus," produced by an increased dose of this drug (article on Chorea). Dr. West, in his Lumleian Lectures, also says: "I have seen one instance in which its employment, while it failed to benefit a somewhat severe case of chorea, was followed by two attacks of violent tetanic convulsions, which nearly proved fatal;" and he adds, "The twitching of the limbs of itself prevents our becoming aware of the dose being excessive, and a child's inability to describe its sensations deprives us of another. For such reasons, Dr. West does not favor the employment of this agent. Still, any agent may be given in an overdose, and it is not difficult to prescribe strychnia in a dose which will be efficient and yet safe for children at the age at which chorea ordinarily occurs. I have employed bromide of potassium in a few cases, but with so little benefit that I am not inclined to continue its use for this disease. Others have not been more successful. However efficacious the bromide may be in epilepsy, it does not appear to be a remedy for chorea.

Cimicifuga, first employed by Jesse Young, of this country, is highly

[1] Diseases of the Nervous System, page 617.

esteemed by Philadelphia physicians in the treatment of chorea. I have employed the fluid extract in doses of half a drachm, increased to one drachm, for a child from six to ten years of age, and though it benefits some cases, it has no appreciable effect either in moderating the movements or abridging the duration of others.

Ether, asafœtida, valerian, musk, the oxide and sulphate of zinc, turpentine, tartar emetic, opium, and numerous other remedies, have been recommended, and some of them have seemed useful in certain cases. In this city sulphate of zinc has been frequently employed as a remedy for chorea, and in gradually increasing doses till more than twenty grains were administered three times daily, but it has not appeared, so far as I have been able to ascertain, to exert any marked influence either on the severity or duration of the choreic movements. Justice, however, requires us to state that Dr. West, who has written recently on the nervous diseases of children, thinks that it has been beneficial in certain cases in which he has employed it, and he regards it on the whole as the best remedy.

Radcliffe, who has had ample experience in the treatment of nervous affections, writes: "In an ordinary case of chorea the plan of treatment which I have now adopted as a rule for some time is to give cod-liver oil, in conjunction with hypophosphite of soda, making the draught containing the latter salt the vehicle for the administration of the cod-liver oil." Sometimes camphor or the sesquicarbonate of ammonia is added. Of more than thirty cases treated in this way, the average duration was under three weeks. Radcliffe began to prescribe these remedies on theoretical grounds, believing that phosphorus and cod-liver oil were required to restore "nerve tone," and the result of this treatment has certainly been such as to commend it to the profession. To children he gives from five to eight grains of the hypophosphite of sodium three times daily.

In those severe cases in which choreic movements prevent the proper amount of sleep, a moderate dose of hydrate of chloral may occasionally be advantageously administered.

Electricity has been many times employed in the treatment of chorea, and though some, chiefly electricians, believe that it has a curative effect, others, and the majority, fail to see any material benefit from its use.

Cold general baths, the shower-bath, frictions along the spine, etc., have been employed; but the local treatment which has so far been most successful, and which promises to supersede all other local measures, consists in the application of ether spray over the spine. About two ounces of ether are employed at each sitting, the spray being applied from an atomizer up and down the whole length of the spine if the chorea be general. The operation, which occupies from ten to fifteen minutes, should be repeated daily or every second day. A considerable number of cases have been reported, in which the spray has apparently had a good effect in controlling the disease. But I repeat my belief, from the large number of cases seen in the Bureau for the Relief of the Outdoor Poor, that the arsenical and ferruginous treatment gives more satisfaction than any or all other measures.

CHAPTER XV.

INFANTILE PARALYSIS.

Paralysis in young children, especially infants, is in most instances due to causes which seldom produce it in adults. The principal cause of it in the adult, namely, cerebral apoplexy, is indeed rare in children. Paralysis in children has the following recognized causes: 1st. A change in the blood, not fully understood, induced by certain grave diseases, as diphtheria, typhoid fever, measles, scarlet fever, etc. 2d. Reflex influence. The function of some part of the system is in some way disturbed, and paralysis occurs in certain muscles, perhaps at a distance from the cause, and it disappears when that cause is removed, unless it have continued too long. The only rational explanation is found in the fact of a continuous connection between the local cause and the paralyzed muscles through the afferent and efferent nerves, and the nervous centres. 3d. Compression or injury of a nerve-trunk. These cases are rare. Pressing of the portio dura by the blades of forceps during birth, described in the next chapter, is an example. 4th. An anatomical alteration in the muscular fibres, the nerves and nervous centres remaining unaffected. This has been designated myogenic paralysis. This form of paralysis is probably often of a rheumatic nature. Paralysis of the face or other portions of the surface, which sometimes occurs in children and adults from prolonged exposure to cold winds, is of this nature. 5th. Some anatomical change in the nervous centres, as congestion, hemorrhage, inflammation, emboli, compression and laceration of brain, whether by tumors, inflammatory products, or other causes, etc. If there be hemiplegia the presumption is that the disease causing it is cerebral; if paraplegia, that it is spinal. The following is a interesting example of hemiplegia. The case was related by me, and the specimen presented to the New York Pathological Society.

Case.—Maggie, aged 2 years 8 months, was admitted into the Catholic Foundling Asylum about the 1st of September, 1874. She seemed to be in good health and was plump and well developed, and her mother stated that she had had no serious sickness. After her admission she continued well, having the usual appetite, amusing herself through the day, and presenting no symptoms to attract attention till December 6th. On the evening of December 5th she ate her supper as usual, and was placed in her crib, *apparently in perfect health.* At 3 A. M., the sister who was in charge of the ward found her in severe general eclampsia. Immediately, in addition to the usual local treatment, she administered five grains of bromide of potassium, and this was repeated at intervals till six or seven doses were administered. Nevertheless, the spasmodic movements continued, with more or less violence, till 1½ P. M., and in the muscles of the leg somewhat longer.

On my arrival at the asylum, at about 6 P. M., I found her lying quietly, rather stupid, but easily aroused. Her vision was evidently good, and she was conscious; the pupils responded to light, and the direction of the eyes was normal; pulse 104, no cough, and respiration natural; temperature, as ascertained by the thermometer in the axilla, also normal. There was no apparent paralysis of the muscles of the face, but the right arm and leg were paralyzed, though the paralysis was not complete. The great toe flexed on tickling the sole of the foot, but the foot itself had little or no motion, and on my attempting to flex the leg, which was extended, some rigidity of the muscles was observed. At times the patient produced slight movement of the thigh upon the trunk. The muscles of the right upper extremity were more flaccid than those of the leg, and motion of the forearm was totally lost, while a little movement remained of the arm on the trunk. During the two or three days succeeding the convulsions sensation in the right limbs did not appear to be entirely lost, though greatly enfeebled. Subsequently paralysis in the right limbs, both of the nerves of sensation and motion, was nearly or quite total, and continued so till death. Nevertheless, tickling the sole of the foot caused some movement of the great toe. On the left side sensation and motion were perfect.

The record of December 9th runs: Has vomiting to-day for the first time; apparently sees well, and appearance of the eyes normal; has no retraction of head, or rigidity of muscles of neck, or along the spine; pulse 96, temperature in the axilla normal; lies quiet and with eyes shut; is stupid, and not fretful when aroused; the bowels move regularly.

December 11th, continues to vomit at intervals; pulse 68. Dec. 16th, pulse 80, temperature 100°; vomited once yesterday, none to-day; lies in a constant doze; takes bromide of potassium gr. iv three times daily. Dec. 18th, moans at times, as if in pain; pulse 180, temperature 100°; takes the bromide gr. iv every four hours.

Dec. 19th, pulse 180, temperature 103°; she has convergent strabismus, and the eyes have a wild, almost insane look, but she sees, grasping hurriedly the percussion hammer presented toward her; paralysis of nerves of motion and sensation in the right extremities nearly complete; slight movement is still produced in the great toe by titillation; the vomiting has ceased; tongue covered with a thick fur; movements of the bowels pretty regular; has a slight cough, such as is common in cerebral disease.

Dec. 22d, lies quietly on her side in perpetual slumber, with eyes constantly shut; pulse 118, temperature 101½°; the bowels still move nearly normally; the pupils, exposed to the light, are seen to oscillate, but are constantly more dilated than in health; the urine passes freely; circumscribed flushing of the features at intervals; a rash like lichen over abdomen and chest, possibly due to the large quantity of bromide of potassium administered. 24th, pulse intermittent; pupils dilated.

Dec. 25th, died in profound stupor to-day, having lived nineteen days from the commencement of the malady.

Autopsy.—About thirty hours after death; weather cool. On removing the calvarium and dura mater, which presented no unusual appearance, the vessels of the pia mater were found rather more injected than usual, but not more so than we sometimes observe in those who die of diseases which do not involve the brain. The cerebro-spinal fluid was scanty, and the surface of the brain rather dry. The vertex of the left hemisphere was unusually prominent, rising perhaps half an inch higher than that on the opposite side. At the highest point, which was about one and a half

inches from the median line, was a circular yellowish spot upon the surface of the brain about one and a half inches in diameter. Pressure upon this spot, made lightly, so as not to produce rupture, communicated the sensation of a large cavity underneath filled with liquid, and approaching to within two or three lines of the surface. There was no adhesion or exudation over this spot; and the surface of the brain appeared entirely normal, except a little cloudiness of the pia mater over a space which could be covered by a five-cent piece, a little posterior to the optic commissure. The incised surface of the brain, at a distance from the abscess, showed no increase of vascularity. The right hemisphere appeared in every way normal, except that its lateral ventricle was filled with pus, but not distended.

On the left side, occupying the centre of the hemisphere, was an abscess as large as the fist of a child of two years, extending from within two or three lines of the vertex, where its site corresponded with the yellow spot on the surface of the brain, to the roof of the lateral ventricle. Through this roof the abscess had burst, filling and distending the ventricle with pus, and thence making its way into the lateral ventricle of the opposite hemisphere. The whole amount of pus contained in the abscess and the two ventricles was, perhaps, two ounces. The walls of the left lateral ventricle were much softened, the upper part of the corpus striatum and thalamus opticus being nearly diffluent; the walls of the right lateral ventricle were slightly softened, but to less depth. The parietes of the abscess, which extended from the roof of the ventricle to the vertex, as already stated, were indurated to the depth of one and a half lines in consequence of proliferation of the connective tissue, except at the base of the abscess, which corresponded with the roof of the ventricle, where softening had occurred. The spinal cord, so far as it could be examined from the cranial cavity, had the usual vascularity, and seemed nearly or quite normal.

The cause of encephalitis from which the abscess resulted was obscure. This inflammation, so far as can be ascertained, was idiopathic, which is known to be a rare disease. There was no history of otitis, which is one of the most frequent causes of cerebral abscess, nor of heart disease, so as to produce embolism. It seems probable, since there was no fever till about the fourth day after the convulsions, that an abscess had primarily occurred in the hemisphere between the roof of the ventricle and the vertex, probably weeks previously. The bursting of this into the lateral ventricles and the constitutional disturbance, inflammation, and softening to which this gave rise afford sufficient explanation of the history of the case after the commencement of the convulsions.

Paralysis occurring as a symptom or sequel of some obvious local or general disease, as diphtheria, lesion of the nervous centres, etc., and which may occur at any age, need not detain us. It is described in connection with the primary diseases on which it depends. But there is a form of paralysis which in the present state of our knowledge we must consider an idiopathic malady, and which is peculiar to the first years of life, or is so rare at other periods that it is proper to regard it as strictly a malady of infancy and early childhood. It occurs between the ages of six months and three years. The following description relates to it:

Symptoms.—The previous health of the patient is usually good. The paralysis does not always commence in the same manner. In a

few instances it begins suddenly in the daytime when the child is apparently in perfect health. In some it begins abruptly, after sound sleep. The child goes to bed well, sleeps through the night, and awakens in the morning paralyzed. I have known it to occur in one instance after sleep in the middle of the day. In these cases there has sometimes been an exposure, before the sleep, to wind or rain, or from sitting upon a cold stone. In other and the majority of cases the paralysis is preceded by a very decided febrile movement, which comes on suddenly, without appreciable cause, and after a few days the power of motion is found to be lost in one or more of the limbs. No symptom occurs during the febrile movement indicative of disease of the brain: consciousness is retained, and there is no more headache or apparent liability to convulsions than is present in other pathological states accompanied by an equal amount of fever. The paralysis is at its maximum in the commencement. Occurring as by a stroke, the full extent of the paralytic state is exhibited at once, and so far as there is any subsequent change, it is an improvement, as regards the number of muscles affected, and the degree of the paralysis. Most frequently the muscles of one or both lower extremities are affected. Occasionally one of the upper extremities is also paralyzed in addition to the lower, but paralysis of an upper extremity is less in degree, and disappears sooner, than that of the lower. The bladder and lower bowel remain unaffected, since only the muscles of volition are involved. Sensation is unimpaired in the affected limbs, and in the commencement there is even in some cases a state of hyperæsthesia (West). The febrile movement which precedes and accompanies the paralysis in certain cases, gradually abates, and in a few days nothing abnormal remains except the loss of power in the affected muscles. These muscles are in a flaccid and relaxed state, so that the limb falls by its weight when unsupported, and they are usually free from pain. The number of muscles paralyzed varies greatly in different cases. Only one muscle or a single group of muscles may be affected, or, on the other hand, both the extensor and flexor muscles of two or more limbs may be paralyzed. In the opinion of Mr. Adams, the following table exhibits the groups of muscles and single muscles most frequently involved, and in the order stated:

Groups.

1. Extensors of toes, and flexors of the foot.
2. Extensors and supinators of the hand.
3. Extensors of leg, and with them usually the first group.

Single Muscles.

1. Extensor longus digitorum of toes.
2. Tibialis anticus.
3. Deltoid.
4. Sterno-mastoid.

The following is an example of infantile paralysis, as it not infrequently occurs when the result is favorable: A. K., German, female, aged 3 years 4 months, fleshy; had been in the habit of sitting on the

ground near the house and on the door-sill. On July 2, 1871, she had a sound sleep in the afternoon, having been entirely well previously, and awoke trembling and with a high fever at 3½ P.M. At 8 P.M., the febrile excitement continuing, general clonic convulsions occurred, lasting about ten minutes. At this time I was called to see her, and found her face flushed, surface hot, and pulse about one hundred and thirty. Consciousness returned after the convulsion. Her intelligence was good, tongue moist and slightly furred, bowels rather constipated, and the urine freely passed. The febrile excitement continued two days, when it gradually and entirely abated, but before it ceased paralysis of the left lower extremity was observed. No weight at first could be sustained upon this limb, and it hung powerless when we endeavored to make her walk. The attempt caused her to cry, as if in pain, and pressing upon the thigh, or moving it, had the same effect. The thigh of this limb did appear slightly swollen on inspection, but measurement did not indicate any notable enlargement. The difference in circumference was not more than one-eighth to one-fourth of an inch. There was no appreciable increase of heat in the thigh over the general temperature of the body. Sensibility remained in every part of the limb, and the loss of power was not complete, for on the first day, as soon as the paralysis was observed, slight and imperfect movements could be produced by pinching the limb. In three weeks the use of the limb was fully restored, by mildly stimulating liniments, and simple medicines to regulate the bowels. The tenderness which was observed in this case is only occasionally present, and has been attributed to hyperæsthesia.

Prognosis—Progress.—The paralysis in nearly all cases soon begins to abate. The power of motion returns little by little, and whatever improvement occurs is permanent. There is no retrogression in the convalescence. The sooner improvement commences, the more favorable is the prognosis. In the most favorable cases there is complete restoration in from three to four weeks. In other patients, while certain of the muscles regain the power of motion, other muscles, oftener those of the lower extremity than upper, do not recover their function, and, unless proper remedial measures be employed, and even with them in certain instances, atrophy soon commences. The temperature of the paralyzed limb falls three, five, or even eight degrees, and the amount of blood which circulates in it is diminished so that the pulse of the limb is feebler and its vessels smaller than in health. With the atrophy the contractility of the muscular fibres by the electric current diminishes, and in unfavorable cases after a time powerful induced and even primary currents have no appreciable effect. The nutrition of a paralyzed limb is always imperfect, and if the paralysis occur in a child, its growth is retarded. Therefore, in cases of protracted or permanent infantile paralysis of one limb, a disproportion occurs both in diameter and length between it and that on the opposite side. If the paralysis continue, the ligaments of the paralyzed limb become relaxed and lengthened. West mentions a case of paralysis of the deltoid in which the humero-scapular ligaments were so extended that the humerus dropped from the glenoid cavity, so as to increase the length of the limb three-fourths of an inch.

In the paralysis of certain muscles of the lower extremity, and continuance of the contractile power in others, we have the conditions which give rise to club-feet, and accordingly this deformity is the common result of the paralysis when it is not cured.

Etiology.—As infantile paralysis is not a fatal malady, opportunity for post-mortem examination in a recent case seldom occurs. Hence the difficulty in determining the exact anatomical change in the nervous system which produces the paralysis. Medical literature contains records of a considerable number of cases in which autopsies have been made, but death occurred so long after the commencement of the paralysis, usually months or years, that it is difficult to determine whether lesions which have been observed were a cause or consequence. In a majority of these autopsies a spinal lesion of some sort was detected, but in some instances none could be discovered.

Mr. Adams, in his treatise on club-foot, relates a case in which the spinal cord, carefully examined, probably only with the naked eye, seemed normal. Robin examined the spinal cord microscopically in one case, but discovered nothing abnormal, and Elischer made autopsies in two cases of this paralysis in which death had occurred from variola, but with a negative result as regards lesions in the nervous system.[1] The examinations by Robin and Elischer, since they were microscopic, have been justly regarded as important, and they have been related by writers in order to sustain the theory that infantile paralysis is peripheral, and not centric.

Very little was effected, prior to 1863, in determining the cause or causes of infantile paralysis by post-mortem examinations, because the microscope was so little used, and because in most of the cases reported the clinical history or microscopic lesions were such as to show or to render it highly probable that the paralysis was not such as is designated and understood by the term infantile. Thus Beraud reported a case in which tubercles were found in the spinal cord. Hutin, a case in which there was atrophy of the lower part of the spinal cord, but the paralysis commenced at the age of seven years. Hammond, a case in which a clot was found in the spinal cord; and Jaccoud, one of spinal arachnitis, with thickening of the meninges. Since 1863, seventeen autopsis have been recorded in which the spinal cord was carefully examined, and upon these we must chiefly rely for our data by which to determine what are the anatomical changes in the nervous system which probably cause this paralysis. The reader will find these cases tabulated in a lecture by E. C. Seguin,[2] M.D., and the most important of them narrated in a paper on infantile paralysis, showing great research, published by Dr. Mary Putnam Jacobi.[3] It is true that all but three of these post-mortem examinations were made many years after the occurrence of the paralysis; but in the three cases which were reported by Roger and Damaschino, only two, six, and thirteen months had elapsed. The following were the chief lesions observed in these cases as regards the spinal cord:

[1] Jahrbuch für Kinderh., 1873.
[2] N. Y. Med. Record, January 15, 1874.
[3] N. Y. Obst. Journ., for May, 1874.

	Cases.
1. Atrophy of motor-cells in anterior cornua	10
2. Nerve-cells, normal	2
3. Atrophy (variously recorded) of anterior columns, or cornua, or part of cord, or roots of anterior nerves	8
4. Sclerosis	9
5. Myelitis, recorded as diffused, central, or slight	7
6. Central softening (the three most recent cases)	3
7. Small clot in cord (Hammond's case)	1
8. Sciatic neuritis	1

It is seen that the most common lesions in these cases were those of inflammation of the spinal cord, or such as are known to result from this inflammation, to wit, atrophy of the nervous substance and sclerosis.

With the data furnished by these post-mortem examinations and the clinical histories of cases, we are the better prepared to consider the theories regarding the etiology of this malady. The views of MM. Roger and Damaschino are entitled to great consideration, since the autopsies which they made were in cases of shorter duration, and therefore nearer the date of the commencement of the paralysis than those which have been reported by other observers. Roger and Damaschino[1] published a series of papers on this malady, which they conclude with the following propositions: "1. The alteration peculiar to infantile paralysis is a lesion of the spinal marrow, which causes the atrophy of muscles and nerves. 2. The seat of this lesion is the anterior part of the gray substance of the medulla, where softened portions of spinal substance are seen. 3. This softening is of an inflammatory nature—in fact, a simple myelitis. 4. Infantile paralysis should, therefore, be called spinal paralysis of children, and be classed among the affections of the spinal marrow, as depending on myelitis."

To determine the exact character and limitations of the cause of infantile paralysis is difficult; but the views of Roger and Dämaschino, as expressed in the above propositions, seem to harmonize more closely with, and to afford a more satisfactory explanation of, the symptoms, history, and lesions, thus far observed in ordinary or typical cases, than does any other theory. Many neuropathists regard suddenly occurring active congestion of the anterior cornua as the cause of infantile paralysis; but there is that close affinity between active congestion and inflammation that they may be regarded as having the same pathological effect in this instance, and therefore the two theories of a spinal congestion and spinal inflammation may be considered as one. It is not improbable that in some of the cases which more speedily recover there is simple congestion; while in the more obstinate cases, and those with inflammatory symptoms, the congestion has passed into an inflammation, or inflammation was present from the first. According to this theory, the atrophy so generally observed in the twelve cases in which autopsies were made, must be considered a degenerative change resulting from the inflammation or from the paralysis. That so accurate an observer and so excellent a microscopist as Robin could detect nothing abnormal in the case which he examined, was probably due to the fact that the inflammation or congestion abated without producing any degenerative changes in the nervous substance.

[1] Gaz. Méd. de Paris, 1871.

Professor Charcot considers atrophy of the motor cells as the cause of the paralysis, but it is much more in consonance with the facts to consider the cellular atrophy a result than a cause. For how could atrophy, which always occurs gradually, and by progressive increase, be the cause of a disease which begins abruptly, and is most intense in the very commencement? Besides, atrophy does not occur without some antecedent disease to cause it.

In a report to the International Congress at Amsterdam, Drs. Damaschino and Roger give the following summary of the result of their recent study of the pathology of infantile paralysis:[1]

1. The anatomical lesions are situated in the motor regions of the spinal cord.

2. They consist of a central myelitis, with a stadium of softening, and atrophic destruction of the cells of the gray substance, together with sclerosis of the lateral columns, and considerable atrophy of the anterior roots and the nerves leading to the paralyzed muscles.

3. Atrophy of the cells is not—as Charcot is of opinion—the whole process, as it is in progressive muscular atrophy.

4. The opinion of Leyden, that there is a circumscribed and a diffuse myelitis in children, is worthy of consideration.

5. It remains for future examination to decide whether the myelitis begins as interstitial or parenchymatous, in the cellular tissue or the nerve-cells.

It would be a waste of time to consider in full the various theories regarding the cause of infantile paralysis. No one at the present time, of those who are competent to express an opinion, believes it to be a reflex paralysis, and the expression dental paralysis once applied to it is no longer heard. There is one theory, however, which should receive more than a passing notice, and which was earnestly and ably advocated by Barwell,[2] of London, in lectures published by him in 1872, to wit: "That this paralysis is purely peripheral; a malady affecting the ultimate fibrillæ of distribution of the nerves among the muscular elements. . . . Its essence," says he, "lies probably in some subtile derangement in relationship between the ultimate muscular and terminal nerve fibres, perhaps from some inflammatory, perhaps from some chemical or nutrient change." This theory has much to commend it. Those who advocate it believe that the atrophy of the nerves which supply the paralyzed limbs and of the motor nerve-cells which connect with the roots of these nerves in the anterior cornua occurs in consequence of the paralysis, just as atrophy of the optic nerve can be traced even into the brain when the eye is destroyed. Nor does it dispose of this theory to state, as has been stated, that in order that paralysis may occur in this manner, it is necessary that there should be the action of a poison, analogous to woorari, for we observe something similar to this supposed peripheral cause in facial paralysis from exposure to cold, in which there can be no poisonous influence. This theory therefore rises up most strongly in conflict with that which attributes the paralysis to congestion or inflammation of the anterior cornua, and

[1] Le Progrès Médical, No. 39, 1880.

[2] London Lancet, 1872.

it is necessary to decide between them, or to admit that the paralysis may sometimes have one and sometimes the other cause. But the fact that there is in many cases of infantile paralysis a decided febrile movement and much constitutional disturbance, when there is no evidence of any morbid action going forward in the affected limbs sufficient to cause these symptoms, and the fact that only one set of nerves is affected, to wit, the motor, which have a distinct origin in the spine from the sensitive nerves, but are intimately associated with them in their distribution, comport best with the theory of a central lesion. Therefore, the theory of spinal congestion or inflammation appears the best established. Nevertheless, past experience shows that medical theorizers are liable to be too exclusive, and that in many diseases the causes are not uniform, but they vary in different cases, especially when, as in the present instance, the symptoms also vary. Possibly, therefore, there may be cases of paralysis of the extremities in children, especially those in which there is little constitutional disturbance and a known exposure to cold, in which the cause is peripheral instead of centric. The brain and cerebral meninges may be excluded as sustaining any causative relation to the paralysis. There is no symptom which indicates that they are involved. The mind remains clear, and convulsions are no more frequent than in any other disease which is attended by an equal degree of febrile movement.

Anatomical Characters.—All muscular fibres which are in a state of disuse, begin in a few weeks to atrophy, and undergo fatty degeneration. The transverse striæ in the primitive muscular fasciculus gradually disappear and are replaced by granules of fat, and later still by small oil-globules. If we examine with the microscope the fibres from a muscle which has been a considerable time paralyzed, but which has still some electric contractility, we will find in places the striæ remaining, but numerous opaque granules of a fatty nature within the sarcolemma wherever the striæ are absent, and in other places, where the degeneration is most advanced, oil-globules occur, always small. If the paralysis be more profound, the striæ have all disappeared. At a later stage, usually after some years in cases of complete and incurable paralysis, the fatty matter may be to a considerable extent absorbed, and the fibrous network of the muscle which remains presents a tendinous appearance. There is a great difference, however, in different cases, as regards the rapidity with which these changes occur. Hammond states that he found the striæ remaining in two cases after the lapse of more than four years of decided paralysis. The nerves of the paralyzed part also undergo atrophy.

Diagnosis.—This is easy as soon as the attention of the physician is directed to the state of the limbs. In a large proportion of cases the mother or nurse first observes the paralysis, and calls the attention of the physician to it. A knowledge and recollection of the facts in relation to infantile paralysis should lead the physician to examine the state of the limbs in all cases of marked febrile excitement in young children, occurring without apparent cause.

Prognosis.—It may be confidently predicted, if the child be seen early, and correctly treated, that the paralysis will diminish, if it can-

not be entirely cured. If the paralysis have continued a considerable time, and there be no electric contractility of the muscles, there is poor prospect of any improvement. The induced current will fail, sometimes, to cause muscular contraction, when the direct current may produce it; but if there be no response to the direct current, there is no therapeutic agent which can restore the use of the limb.

In cases seen soon after the paralysis commences, and before the stage of atrophy, the prognosis is most favorable, when there is still slight voluntary motion, and improvement commences early. In most instances, even when the paralysis has been mild, and of comparatively short duration, the limb, although its motion be fully restored, is for a long time weaker than the limb on the opposite side.

TREATMENT.—A physician called at the commencement of the paralysis should endeavor to remove every cause which might increase the irritability of the nervous system. Some advise to scarify the gums, if much swollen and tender from dentition, the bowels should be kept regular, worms, if present, expelled by appropriate medicines, and the diet be plain and unirritating. Since the cause of the paralysis is, in the commencement, still operative, measures are appropriate which are calculated to remove it.

Local treatment is very important at all periods of the paralysis. In the first days cold applications, as by an India-rubber bag containing ice, should be made over the spine. Stimulating embrocations over the spine, and upon the paralyzed limb, are appropriate after the cold has been discontinued, and benefit may also be derived from dry cups along the spine. Ergot, the bromide and iodide of potassium, which may be administered variously combined, or singly, are the appropriate remedies for the first twelve or fourteen days. Administered every three or four hours in proper dose, they are the most effectual of all internal remedies for diminishing spinal congestion, and preventing effusion, and permanent structural change in the cord. Unfortunately this first stage is in many instances far advanced before proper treatment is employed to subdue the myelitis, either from an incorrect diagnosis, or because the physician is not summoned until structural changes have occurred, which constitute the second stage.

If the paralysis continue, or if it do not progressively diminish, we should not delay more than two weeks from the commencement of the disease before employing appropriate measures to restore the use of the limbs, and arrest atrophy of the muscles. The expectant plan of treatment which is proper in many diseases of children is unsuited to this. Muscular atrophy may commence in three weeks, and the further it has advanced, the more difficult and tedious will be the cure. Therefore, by the close of the second week if the paralysis continue, or be not rapidly disappearing, iron as a tonic with strychnia should be prescribed. There is probably no better formula for the exhibition of these agents than the following from Professor Hammond:

℞.—Strych. sulphat. . . . . gr. j.
Ferri pyrophosphat. . . . . ℥ss.
Acidi phosphorici dilut. . . . . ʒss.
Syr. zingib. . . . . ʒiijss.—Misce.

One-third of a teaspoonful, or one-ninetieth of a grain of strychnia, is sufficient for a child of two years, administered three times daily. Hillier, Barwell, and others have employed subcutaneous injections of strychnia, with, it is stated, a good result. While in the first and second weeks the child has been allowed to remain quiet, he should now be encouraged to use his limbs. Frequent muscular contraction must, if possible, be produced, and the voluntary movements, when not totally lost, aid greatly in promoting the nutrition of the muscles and restoring their function. Immersing the limb for half an hour in water at a temperature of 110 or 115 degrees, rubbing the limb with a coarse towel, and kneading the muscles, aid also in restoring nutrition and tone to them.

But, fortunately, we have an invaluable agent in the subtle electrical fluid, which can be made to penetrate the muscles and cause their contraction when every other measure has failed. The induced current should be employed upon the limb every day, or second day, if it cause the muscles to act, but if the loss of power be of long standing, or complete, so that the induced current is not sufficiently powerful, the direct current should be used instead. It is not regarded as important which way the current passes, provided that the muscles contract.

In a large proportion of cases a cure cannot be effected until the lapse of several months, so that the patience of the physician and friends may be put to the test; but if muscular atrophy can be prevented, and the limb kept at nearly the normal temperature, this mode of treatment will ordinarily in the end be successful. The primary affection which caused the paralysis will, with some exceptions, be removed by the treatment indicated above, after which the state of the muscles and their nervous supply demand the whole attention. Observations show that by treatment perseveringly employed, fatty degeneration of the muscular fibres can be not only arrested, but the fat which has already been deposited within the sarcolemma may be absorbed, and the muscular striæ restored. In those cases in which it has been necessary to employ the direct current, the induced should be used, whenever by the improvement of the case it is found sufficiently powerful.

CHAPTER XVI.

FACIAL PARALYSIS.

Causes.—Facial paralysis, in the newborn, commonly occurs from pressure of the blade of the forceps upon the portio dura, at a point external to the stylo-mastoid foramen. It may also occur in children of any age, from exposure of the face to a cold wind. The pressure of a tumor upon some part of the portio dura, or even of the fist of the child

placed under the face during sleep, may cause it. It may also result from disease of the temporal bone, producing pressure on the nerve, as caries, periostitis, suppuration, or hemorrhage into the aquæductus Fallopii, and also from intracranial disease affecting the pons Varolii or the medulla oblongata.

SYMPTOMS.—The portio dura, which is a nerve of motion, supplies the muscles of the face, and therefore its loss of function is at once manifest in distortion of the features. The eye of the affected side remains open in consequence of paralysis of the orbicularis palpebrarum, the upper lid being raised by the levator muscle, which is not paralyzed, since its nerve is derived from the third pair. From the inability to wink, the eye becomes irritated by dust and constant exposure, and, in children old enough to have an abundant lachrymal secretion, the tears are liable to flow over the cheek. On account of the paralyzed and relaxed state of the facial muscles the mouth is drawn toward the healthy side, while the affected side presents a swollen appearance. Movement of the eyebrow of the anterior portion of the scalp on the paralyzed side is also impossible, since the occipito-frontalis and corrugator supercilii are supplied by the portio dura. If the cause of the disease be located above the origin of the chorda tympani, the flow of saliva and sense of taste on the affected side are impaired. If the injury be posterior to the gangliform enlargement, those symptoms are superadded which are due to paralysis of the petrosal nerves.

The accompanying woodcut represents a case which was under observation in the New York Infant Asylum. Its age at admission was about five months, and its previous history was unknown. The paralysis was permanent. Death occurred some months later from an intercurrent disease, and no cause of the paralysis could be discovered in a careful examination.

PROGNOSIS.—This depends on the cause. If the cause be peripheral, as from the pressure of the forceps or from cold, the prognosis is favorable. In cases of deep-seated lesion, unless syphilitic, the prognosis is usually unfavorable. A syphilitic lesion can often be removed by appropriate remedies, and the paralysis cured.

FIG. 31.

TREATMENT.—In the paralysis of the newborn, from pressure of the forceps, all that is required is occasional rubbing or gentle kneading over the affected muscles. In those who are older, the nature of the cause, so far as ascertained, must determine the treatment. If there be glandular swellings, and discharge from the ear from scrofula, cod-liver oil and the syrup of the iodide of iron are required internally, with appropriate external treatment of the glands and ear. If syphilis be the cause, mercurials and the iodide of potassium should be employed. If the patient do not soon begin to improve, the treatment recommended for infantile paralysis, modified

somewhat on account of the difference in location, is appropriate. Iron and strychnia may be administered internally. The external treatment should consist of friction, kneading, hot applications, and the electric current. The current should have only moderate intensity, for a high degree of it might injure the vision. It should be applied every second day, with one pole over the mastoid foramen, and the other moved slowly over the muscles.

Paralysis with Pseudo-Hypertrophy.

This is a rare disease. It was first described by Duchenne in 1861, and since the attention of the profession was directed to it, cases have been observed on the Continent, in Great Britain, and in this country. Though our acquaintance with it is so recent, it has been fully and accurately described by various writers in our language. The *Transactions of the London Pathological Society* for 1868, contain a translated paper relating to it, communicated by M. Duchenne, with photographic views and remarks by Lockhart Clarke, and also the histories of two cases occurring in London, and exhibited to the Society by Adams and Hillier. In this country an elaborate paper has appeared on this form of paralysis, from the pen of Dr. Webber,[1] of Boston, who succeeded in collecting the records of forty-one cases; and more recently Dr. Poore,[2] physician to the New York Charity Hospital, collated the records of eighty-five cases, which furnish the material of an excellent monograph.

Weakness of the legs, and a peculiar waddling gait, are the first observable symptoms, and by them we are able to ascertain approximately the date of the commencement of the paralysis. In 27 of the cases collated by Dr. Poore, the malady began so early in infancy that they were never able to walk like other children; in 5 there is no record in regard to the time when the peculiar gait was first observed, or whether they ever could walk. Fifty-two, or about two-thirds of the cases, walked well at first, having no symptoms of the paralysis till after the age of two years. In 15 of these, weakness of the legs and the peculiar gait were first observed between the ages of two and a half and five years; in 23 between the ages of five and ten years; in 6 between the ages of ten and sixteen years, and in 8 over the age of sixteen years. It is seen, therefore, that this malady is preëminently one of infancy and childhood.

The gait, which is unsteady and waddling, has been compared to that of a duck. The child stands with the legs wide apart, and from the weakness of the legs, and unsteadiness of the gait, frequently stumbles and falls. In many cases this muscular weakness and difficulty in walking occur before there is any perceptible enlargement of the muscles beyond the normal size.

The hypertrophy occurs without tenderness, pain, or other nervous symptoms, and without fever or constitutional disturbance. Occasion-

[1] Boston Med. and Surg. Journ., Nov. 17, 1870.
[2] New York Medical Journal for June, 1875.

ally the patient complains of stiffness or aching in the limbs, especially after exercise, even before the enlargement is observed, and exceptionally there is pain, even acute, in the legs. The hypertrophy is ordinarily observed first in the calf of one leg, and then in the opposite calf. In a case related by Niemeyer, the muscles of the gluteal region were first affected. In nearly all cases the gastrocnemii are hypertrophied. There were only two exceptions in the 85 cases collated by Dr. Poore; but almost any of the other muscles, or groups of muscles, may also be involved. The muscles which are most prominently affected, and which produce the characteristic deformities, are those of the extremities and posterior aspect of the trunk. Spinal curvature, which is attributed to the weakened state of the erector muscles of the spine, appears early, and is seldom absent. The bending is such that a plumb-line, falling from the most posterior of the spinous processes, falls behind the plane of the sacrum, which is a means of distinguishing this disease from certain other spinal affections. The woodcut represents a case which came to the children's class at Bellevue, in April, 1872. The boy was two years old, and the mother stated that the peculiar gait and the enlargements had only been observed from four to six weeks, and yet the curvature of the spine was quite marked. He did not return to the class, and his subsequent history is therefore unknown.

Of the muscles in the upper extremities the deltoid and scapular are the most frequently enlarged. Hypertrophy of the temporals has been observed in three cases, of the masseters in two, of the tongue in three, and of the heart in four (Poore).

Fig. 32.

We shall see presently that atrophy occurs in the muscular element of the parts which are affected, and that the hypertrophy is due to hyperplasia of the connective tissue. Now occasionally this hyperplasia does not occur or is tardy in occurring, while the atrophy has taken place. Therefore, certain muscles may have less than the normal volume, which, from contrast with those which are hypertrophied, increases the deformed appearance. In ordinary cases the enlargement advances more rapidly and continues greater in the gastrocnemii, which are, as we have stated, the muscles first affected, than in other muscles, and therefore there are more prominence and hardness of the calves of the legs than elsewhere. In advanced cases walking is impossible, and the patient is obliged to remain in a reclining posture. Sometimes from the unequal muscular action the feet become extended and the toes flexed, so that the child, in attempting to walk, steps on the anterior part of the sole of the foot, as in talipes equinus.

In the first stages of the disease the electric contractility of the muscles is nearly normal, but in advanced cases response to the galvanic

current becomes more and more feeble, according to the degree of atrophy of the muscular fibres. The skin retains its normal sensibility, with exceptional instances in which there is numbness either general or in places. Reddish or bluish mottling of the surface of the extremities is sometimes observed, which is attributed by some to obstructed venous circulation in the hypertrophied muscles, and by others is supposed to be due to the peculiar neuropathic state. The bladder and rectum are not involved. The mental faculties are more or less blunted and feeble in certain cases, especially in those which commence in early infancy, but in some patients they do not seem to be materially impaired.

Anatomical Characters.—There have been so few post-mortem examinations of those who died having this disease, that it is still uncertain whether there is any centric lesion. Cohnheim examined the spinal cord in one case, and could find nothing abnormal. Recently, Mr. Kesteven has examined the brain and spinal cord from a case, and found dilatation of the perivascular canals, both in the brain and spinal cord, and also spots of granular degeneration chiefly in the white substance, "caused by loss of cerebral tissue replaced by morbid matter."[1] As this child was imbecile, it is not improbable that these lesions were connected with the mental state, and not the muscular disease.

Professor Charcot[2] reports a careful microscopic examination of the spinal cord and of the nerves in a case which had continued ten years. He could discover no deviation from the healthy state. More recently Dr. J. Lockhart Clarke[3] examined a case and found the encephalon healthy, but in the spinal cord there was more or less disintegration of the gray substance in each lateral half, and in places dilatation of vessels, and commencing sclerosis.

It seems, therefore, that central lesions are not essential, and are sometimes absent. When they do occur, it is probable that they are consecutive to the paralysis.

The essential lesions in this malady are atrophy of muscular fibres and hyperplasia of the connective tissue which surrounds these fibres. The hyperplasia of the one element in the muscle is greater than the atrophy of the other, and hence the increase of volume above the normal size. The atrophy is probably a primary lesion, for muscular weakness ordinarily occurs for a considerable time before there is any evidence of the enlargement, and, as we have seen, certain muscles may undergo the atrophy without the hyperplasia. Still the mechanical effect of the newly formed connective tissue, doubtless, increases the atrophy in those muscular fibres which this tissue surrounds, and the comparatively quiet state of muscles in consequence of paralysis not only tends to promote the atrophy and degeneration of these muscles, but also of contiguous healthy muscles.

The muscles which are involved in this paralysis present a pale yellowish hue, resembling, says Niemeyer, the appearance of lipoma. Examining by the microscope, we find in addition to a large increase in the fibrous tissue and atrophy, and in some places disappearance of the

[1] Jour. of Med. Sci., Jan. 1871.
[2] Archiv. de Physiol., March, 1872.
[3] Medico-Chir. Trans., 1874.

muscular element, more or less fatty matter, granular and globular, occupying the interstices. Mr. Kesteven describes as follows the appearance of the muscles in the case which he examined: "The muscular substance is pale, almost white, and very greasy. The superabundance of fat is evident to the naked eye. The muscular fibres present the ordinary striation, but less distinctly than usual. The ultimate fibres are pale, and separated by a large increase of areolar and fibrous tissue."

CAUSES.—Why there is this strange perversion of nutrition, so that there is an exaggerated development of the connective tissue of the muscles and atrophy of the muscular fibres, is unknown. Boys are more liable to be affected than girls. Of the eighty-five cases embraced in the statistics of Dr. Poore, seventy-three were boys, and there was a similar excess of males in the cases collated by Dr. Webber.

There is in a considerable proportion of cases the record of hereditary transmission, and in almost all the instances the predisposition is acquired from the mother's side. Thus in thirty-seven of Dr. Poore's cases "two or more belonged to the same family." In some instances three and even four maternal relatives had this form of paralysis. In one case observed by Duchenne, and in a few others subsequently observed, this malady seemed to be congenital, for the limbs at birth were unusually large, and the patients, when they came under observation, were unable to walk. No relation has been observed between this paralysis and syphilis, scrofula, or other diathesic diseases.

PROGNOSIS.—This disease is in most instances progressive, terminating fatally after a variable period. It is in its nature chronic, rarely ending in less than five or six years. A considerable proportion live longer, some even attaining adult age. The paralysis may be stationary for a time, but afterward continue to increase. Duchenne has reported one case of recovery. In two or three other instances patients appeared to improve somewhat under treatment, but the writers admit they may have become worse afterward. Death usually occurs, not directly from the paralysis, but from some intercurrent disease, especially of the lungs.

TREATMENT.—The treatment thus far employed has been chiefly local, consisting in the use of electricity, and kneading or shampooing over the affected muscles. Both the primary and induced electrical currents have been employed, but, unfortunately, without any appreciable benefit in most cases. Benedikt, who claims a better result from electrization than any other observer, applied the copper pole over the lower cervical ganglion, and the zinc pole along the side of the lumbar vertebræ by means of a broad metallic plate.

CHAPTER XVII.

DISEASES OF THE SPINAL CORD AND ITS COVERINGS.

The diseases of the spinal cord, and of the parts which cover and protect it, are important, but they are less understood than are those of any other portions of the body. This is partly due to the fact, that in many cases the spinal disease coexists with a similar pathological state of the brain or its meninges, the symptoms of which predominate and mask those which pertain to the spine, partly to the fact that the chief symptoms of spinal disease are often located in organs or parts which are at a distance from the spine, and, lastly, to the fact that it is difficult, for obvious physical reasons, to determine the exact state of the spine at the bedside; while post-mortem inspection of the spine, which alone can give accurate pathological knowledge, is less frequently made than of any other organ.

Certain spinal diseases occurring in childhood are the same as in adult life, presenting identical symptoms and lesions in the two periods, and therefore they require no extended notice in this treatise. Others are common to childhood and maturity, but they present peculiarities in the former period which require to be pointed out, while others still are peculiar to childhood.

Spinal irritation is not infrequent in delicate and poorly fed children. I have from time to time observed marked cases of it in the class in the Outdoor Department of Bellevue, the patients usually being above the age of three or four years, and exhibiting evidences of cachexia. Most of them have been spare and pallid, some affected with a nervous cough or palpitation, and some with neuralgic pains in the chest, abdomen, or elsewhere, which pressure at a certain point upon the spine intensified. These cases recover by better feeding, outdoor exercise, mild counter-irritation along the spine, and the use of tonics, especially of iron.

Primary inflammation of the cord and its meninges is rare in children. Secondary inflammation of these parts is, on the other hand, more common in children than in adults. It is common in caries of the vertebræ, and in cerebro-spinal fever. The preponderance in functional activity of the spinal cord, and the feeble controlling power of the brain, render childhood more liable to convulsions and reflex paralysis than any other period of life. Until within a recent period, most cases of infantile paralysis were believed to be reflex, due to dentition, intestinal irritation, etc., but it is now attributed to myelitis in the motor region of the spinal cord (see remarks in article, Infantile Paralysis). Still there are cases of true reflex paralysis in children, in regard to the etiology of which there can be no doubt. Prof. Sayre, of this city, has called attention to the fact, that balanitis and preputial adhe-

sions sometimes cause paraplegia, more or less pronounced, in young children, and which is relieved by dividing the adhesions, and restoring the mucous surface of the glans and prepuce to its normal state. Such a case was brought to the children's class in the Outdoor Department at Bellevue, in April, 1875. The child could not walk, or scarcely stand, without support, but after the division of the adhesions, and subsidence of the inflammation, locomotion rapidly improved.[1] It is well known that masturbation sometimes causes a similar weakness of the lower extremities. Dr. West relates the case of a child "between two and three years old," who began to totter in his gait, and finally almost ceased walking. He was observed to practise masturbation. "This was put a stop to," and he soon recovered his health and his power of locomotion.[2]

Congestion of the Spinal Cord and its Membrane.

Congestion of the spinal cord and meninges occurs both as a primary and secondary malady, the latter being more frequent than the former. It may be active or passive. Active congestion, occurring independently of meningitis or myelitis, is in most instances transient, and subordinate to some graver disease, in the course of which it arises. It is probably often overlooked. It is not fatal, and its symptoms are frequently masked by those which are referable to the brain or some other organ. It is believed to be common in the initial period of certain of the fevers of childhood. It is not improbable that the hyperæsthesia observed upon the thoracic and abdominal surfaces and along the thighs, in the commencement of remittent and certain other febrile diseases, has its origin in a congested state of the spine. To this congestion writers attribute the lumbar pain and occasional paraplegia in the initial stage of variola. Active spinal congestion may also result from the sudden impression of cold, and to it, as has been stated above, most neuropathists attribute the so-called infantile paralysis or poliomyelitis acuta.

Certain anatomical circumstances favor the occurrence of passive congestion of the spinal cord and meninges, to wit, the tortuousness of their veins, and the absence of valves in these veins, the lack of muscular support of the vessels, and the inferior position of the spine in sickness as the patient lies quietly in bed. A common cause of passive congestion of these parts is some protracted and enfeebling disease, which diminishes the contractile force of the heart (cardiac paresis), producing congestion of the spinal cord in the same manner as under similar circumstances hypostatic congestion of the lungs occurs. Severe convulsive diseases, as tetanus or eclampsia, when protracted or occurring at short intervals, commonly produce spinal congestion. In tetanus, this

[1] Some months since I requested Drs. Holgate and Bosley, attending physicians in the children's class at Bellevue, to make examination of the state of the prepuce in infancy. They report that they have found preputial adhesions almost daily, in most instances without symptoms, but sometimes with dysuria, and only in rare instances with paralysis.

[2] Diseases of Children, page 146, 4th American edition.

congestion is extreme, so that extravasation of blood is liable to occur from the engorged vessels, especially those of the pia mater.

Anatomical Characters.—It is often impossible, at post-mortem examinations, to determine how much of the congestion of the spine and its meninges is pathological, and how much cadaveric; since, if the corpse be placed on its back at death, a very considerable engorgement of the spinal vessels occurs from gravitation of blood. If the body have been placed on the side or face, this cadaveric congestion is prevented. Since, in active congestion, the arterioles and capillaries are distended with arterial blood, the color is a brighter red than in passive congestion, in which venous blood predominates. *Active* congestion of the cord usually coexists with that of the meninges, but it may occur without it. In cases of considerable congestion, the "puncta vasculosa" appear upon the incised surface, both of the white and gray substance. If the congestion be protracted, or if it recur frequently, it may produce permanent dilatation of the arterioles and capillaries, in greater or less degree, and it may also lead to sclerosis of the cord. *Passive* congestion seldom, perhaps never, occurs in the cord, without being equally and often to a greater extent present in the meninges. Continuing for a time it gives rise to transudation of serum into the interspaces over the cord, and even softening of the cord may occur to a limited extent from imbibition of serum. In either form of congestion, extravasations of blood are frequent.

Symptoms.—Spinal congestion is announced by pain in the region of the spine, usually in the lumbar, or dorsal and lumbar portions, and irradiations of pain, and tingling in the legs. In addition, more or less paralysis of the bladder and legs may result. The paraplegia may occur early or not till the lapse of several days. In active congestion, the symptoms are rapidly developed, and they attain their maximum intensity sooner than in the passive form. In passive congestion the development of symptoms is not only more gradual, but they are ordinarily less pronounced, and are attended by more fluctuation than in the active form. The paralysis, if present, comes on slowly after several days and is incomplete. Spinal congestion, especially of the passive form, is sometimes associated with cerebral congestion, as for example in tetanus and severe eclampsia, and the spinal symptoms therefore coexist with those which have a cerebral origin. The duration and the result of a hyperæmic state of the spinal cord and its meninges, depend largely on the nature of the cause. If it be not relieved within a few days there is strong probability that some other serious pathological state has supervened, as meningitis, myelitis, extravasation of blood, or serous transudation, with softening of the nervous substance.

Treatment.—In the adult, spinal congestion sometimes results from the sudden cessation of the hemorrhoidal or catamenial flow, and the application of leeches or wet cups along the spine is indicated. But in the child, the abstraction of blood is seldom required. In the acute stage of active spinal congestion, with decided febrile movement, cold applications along the spine are often beneficial, as by an India-rubber bag.

In active hyperæmia, laxatives are useful, and rubefacient applica-

tions should be made along the spine, as by mustard, or by friction with a stimulating liniment. In the inflammatory spinal congestion of cerebro-spinal fever, I have employed with a very satisfactory result a liniment containing equal parts of camphorated oil and turpentine. In both active and passive hyperæmia lateral decubitus should be prescribed rather than dorsal. The use of ergot, in order to diminish the turgescence of the vessels of the spinal cord and meninges, has been advocated by Brown-Séquard, and it is now one of the recognized remedies. Bromide of potassium is also a remedy of value, but it is more useful in certain cases than in others. It is signally beneficial in those cases in which there is also cerebral congestion. When the congestion is increased or produced by clonic convulsions, the bromide is one of the most reliable remedies which we possess for the removal of the cause. Thus it should be employed in the treatment of the spinal and cerebral congestion in the commencement of variola, in which convulsions are so common, and in the convulsions of pertussis, which cause extreme passive congestion of the cerebro-spinal axis. Passive congestion of the spine, common in exhausting diseases, and due to feebleness of the circulation, is best treated by stimulating and sustaining remedies, and by the lateral decubitus. It is hypostatic, and may be associated with a similar congestion in the posterior part of the lungs.

CHAPTER XVIII.

SPINA BIFIDA.

This is one of the most common of the malformations. In its severe form it is from its nature incurable, admitting only of palliative treatment, while in its milder forms it may be cured, or so relieved as not to compromise life. The term spina bifida is applied to a hernia of the spinal meninges, which produces a rounded tumor, situated posteriorly over the spine in the median line. It is due to the congenital absence or incompleteness of one or more of the arches of the vertebræ. In exceptional instances, the arch is said to be complete at birth; but the lateral portions separate, and are pressed outward during the first weeks of life. The tumor contains the cerebro-spinal fluid, and unless it be small, and its walls unusually thick, fluctuation may be detected in it. When the child cries the tumor enlarges, and it is reduced by compression, the fluid reëntering the spinal canal. If the tumor be large, its complete subsidence by pressure often produces dangerous cerebral symptoms. Spina bifida is the counterpart of hydrocephalus, and the two often coexist. If we compress the hydrocephalic head the spinal tumor increases, and *vice versâ*. Club-foot is another not infrequent

complication. In the case which is represented in the accompanying woodcut, hydrocephalus, spina bifida, and clubfoot coexisted. The child was brought to the children's class in the Outdoor Department at Bellevue, and after a few visits I lost sight of it. It probably died soon after, since the tumor, over which the cuticle was wanting, presented a deep red appearance as if inflamed, so that ulceration and escape of the fluid seemed near at hand. There is ordinarily but one spina bifida, the common seat of which is the lumbar region, but occasionally two or more are present. If the aperture through which the tumor protrudes be small, it is usually pedunculated, but if large, it is sessile. In some patients it is covered by skin, which may be normal or somewhat indurated; in others the skin is absent over the entire tumor or its most prominent part, and the dura mater or the connective tissue lying directly over the dura mater is exposed, and is liable to inflammation from friction. If the walls of the tumor be thin the liquid may transude in drops, and they are liable to give way by ulceration or rupture. Sudden

Fig. 33.

escape of the liquid, and collapse of the spina bifida, involve great danger, for convulsions, coma, and death are the probable result.

The relation of the spinal cord or nerves, or of the cauda equina, to the tumor, is a matter of great importance. In many patients the adjacent portion of the cord or cauda equina, is deflected through the aperture, and lies against the interior of the sac. Spinal nerves also not infrequently lie within the sac, some returning into the spinal canal, and others passing through the walls of the sac to their points of distribution. Those which are deflected into the tumor and return into the canal obviously lie lowest. In the most favorable cases, to wit, those with a small aperture, or small tumor, or a narrow and long peduncle, neither the cord, cauda equina, nor nerves lie within the sac. It is important to the practitioner to bear in mind that in all probability, unless under the favorable anatomical circumstances stated above, the sac contains nervous elements. In rare instances the liquid, instead of lying externally to the cord, lies within its central canal. The substance of

the cord then becomes distended, and it encloses the liquid like a delicate sac, just as the hemispheres of the brain are unfolded and expanded in the common form of congenital hydrocephalus. As might be expected from the anatomical characters of the more serious forms of spina bifida, paralysis, more or less complete, of the vesical and rectal muscular fibres, and paraplegia sometimes occur, in which event the fatal issue is probably not far distant.

Diagnosis.—This is easy in ordinary cases. The congenital nature of the tumor, and the bony edge of the aperture, appreciable to the touch, suffice in ordinary cases to establish the diagnosis. The diminution of the tumor by pressure, and its enlargement when the child cries, are important diagnostic signs. There are various lumbo-sacral tumors located in the median line, from which it is important that spina bifida should be diagnosticated. Sometimes a cyst occurs in this situation which was originally a spina bifida, but obliteration of the canal in the pedicle occurred, just as the canal connecting a hydrocele with the abdominal cavity closes. Solid congenital tumors sometimes also occur in the same situation, among which, as most common, may be mentioned fatty tumors, and tumors containing fœtal remains. The most common seat of tumors which enclose fœtal remains is at the point where spina bifida ordinarily occurs. Physicians have erred in confounding these tumors, as well as those which consist of fat, with spina bifida; but a mistake in diagnosis can only occur through haste or carelessness of examination.

Prognosis.—This is in most instances unfavorable. Ordinarily the tumor increases slowly, and finally the sac gives way by ulceration or rupture; the liquid escapes, and death occurs in convulsions and coma; or, if the escape of the liquid be prevented by pressure, and the aperture closes, a second rupture is probable with a fatal result. In other cases the tumor may not rupture, but the cord is softened, or it is injured by being bent, so that paraplegia results, and death after a time occurs in a state of emaciation. Rarely the tumor may shrivel by absorption of the liquid, and the disease is cured, or so nearly cured that it gives no inconvenience, and the patient lives for years. In other rare instances the tumor may remain without any material change, and without giving rise to symptoms. The spina bifida being small and covered with skin, and the aperture leading from it into the spinal canal being also small, the patient lives through the natural period of life with little inconvenience.

Treatment.—It is evident, from what has been stated, that no fixed rule can be laid down for the treatment of the spina bifida. In the most favorable cases, in which no symptoms occur, and there is no indication that the tumor will change or undergo any unfavorable change, surgical treatment is not required, except the application of a soft pad to support the tumor, so as to prevent its injury by friction. Indications which justify active surgical interference are growth of tumor, absence of skin from it, with tension of the parietes, so that an early rupture is inevitable, and dangerous nervous symptoms, as convulsions or paraplegia.

From the nature of spina bifida it is evident that operations upon it

must be conducted with caution. The usual presence of the spinal cord in the pedicle and in the sac forbids ligation and excision, and renders attempts to obliterate the sac hazardous, by producing inflammation within it. A safe mode of treatment, but not the most efficient, is to puncture the sac and withdraw a portion of the liquid by a grooved needle or hypodermic syringe. A soft pad should then be applied to produce gentle compression. If no unfavorable symptoms occur, the puncture may be repeated after a day or two. This operation has been employed with a satisfactory result by Sir Astley Cooper among others; but, simple as it is, it is not devoid of danger, for the removal of the liquid, if carried beyond a certain point, may produce dangerous nervous symptoms, especially convulsions. In performing the operation, the puncture should never be made in the median line, on account of the danger of wounding the cord, which lies against the median portion of the sac. The veins, also, should be avoided.

Another mode of treatment is by iodine injections. They are preferable to other methods, if the neck be long and pedunculated, so as to be easily compressed. If the tumor be sessile, and the aperture into the spinal canal be free, these injections involve great danger, and are not to be recommended; for more or less of the solution will inevitably enter the spinal canal, and give rise to spinal meningitis. Iodine injections have been employed with success by Professor Brainard, of Chicago, who states that he "perfectly and permanently cured" three of seven cases; and by Velpeau, of Paris, by whose method five in ten operations were successful, and by many others. Professor Brainard withdrew some of the liquid contents, and then injected half an ounce of water containing $2\frac{1}{2}$ grains of iodine, and $7\frac{1}{2}$ grains of iodide of potassium. In a few seconds this was allowed to flow out, and the sac was then washed out with tepid water. Then a portion of the cerebro-spinal fluid, which had been kept warm, was returned into the sac. When he had withdrawn six ounces of this fluid he returned two ounces. In employing the iodine, or any other irritating injection, it is necessary to compress the pedicle, so that the liquid does not enter the spinal canal. Velpeau employed one part of iodine, one of iodide of potassium, and ten of distilled water.

During a debate in the Société de Chirurgie, M. Debont recommended the evacuation of only a little of the fluid, and the injection of two or three drops of the tincture of iodine diluted with an equal quantity of water. T. Smith,[1] by the injection of one drop of the tincture, produced an amount of inflammation which nearly obliterated the sac. Since statistics show so good a result of iodine injections, this mode of treatment seems preferable to any other for certain cases, and as one drop has produced general inflammation of the sac and nearly obliterated it, it seems safest and best to begin with so small a quantity.

If there be reason to believe, from the small size of the orifice and other anatomical characters, that neither the cord, cauda equina, nor any of the spinal nerves lie, within the sac, it may be thought best to remove the tumor. It has, indeed, been proposed to open the tumor, immersed

[1] Holmes's Surg. Dis. of Children.

under warm water sufficiently to observe the relation of the nervous elements, and to press them back gently into the canal if they lie within the sac. If it be decided to remove the spina bifida, a clamp, or elastic band, is placed around the pedicle so snugly as to cause firm adhesion of the walls of the pedicle, and excite sufficient inflammation in them to produce agglutination, but without causing strangulation or suppuration.

After a time, perhaps two or three days, when it is evident that agglutination has occurred from the fact that the liquid cannot be returned within the spinal canal by compressing the sac, the tumor may be removed by the knife or écraseur. Statistics do not show so favorable a result of this operation as of the iodine treatment, and the reason is obvious for it is only in exceptional cases that the tumor can be removed without injury to the nervous tissue, and excision of a portion of the cord, or of important nerves, either produces death or a condition to which death would be a relief.

Spina bifida has also been treated by opening the sac on its side, pressing back the spinal cord or its nerves into the spinal canal, uniting the edges of the wound, and then applying pressure to prevent protrusion, but the result has not been favorable. Treatment by simple puncture, followed by compression, and if it fail, as it probably will, the cautious use of iodine injections is the preferable mode of treating ordinary cases of spina bifida which require surgical interference.

CHAPTER XIX.

VERTEBRAL CARIES.

Vertebral caries, designated also Pott's disease, occurs chiefly in childhood, but now and then adults are affected with it. It is an osteitis of the bodies of one or more vertebræ, ending in their ulceration and a lifelong deformity, if not checked.

Causes.—A reduced state of system, and especially the scrofulous diathesis, strongly predispose to caries. Hence this malady is more common in the city than in the country, where better hygienic conditions produce a more vigorous constitution. Prolonged antihygienic conditions and protracted ill-health from whatever cause predispose to caries. In certain cases, there is no apparent exciting cause, while in others there is the history of a fall upon or some injury of the spine.

Vertebral caries may occur in the cervical, dorsal, or lumbar portions of the spinal column, but it is more common in the lower dorsal than elsewhere. With the development of the osteitis, the body of the vertebra which is affected becomes hyperæmic, and the spongy tissue is soon

infiltrated with blood and pus. The bone becomes swollen and softened, and, therefore, less resisting than in the healthy state, so that it yields under the weight of the shoulders and head, which it sustains. Therefore, after the osteitis has continued a certain time, there begins to be posterior convexity or rather angularity of the spine, for while the vertebral bodies soften and yield by the weight above them, the arches retain their integrity and firmness, and are unyielding.

Much of the tediousness and suffering of this malady are due to the fact that the inflammation is so deep-seated, and a healthy bony barrier is interposed between it and the surface, so that there is no ready escape of the pus. It permeates the spongy tissue, filling the cavities produced by the softening and absorption of the bone-substance. If the inflammation be of small extent, the amount of pus small, the constitution good, and if the disease be early recognized and properly treated, the child may recover without any fistulous opening, by absorption of the pus, and with little remaining deformity.

In the large proportion of cases, however, the history is different. The disease is not recognized till the stage of deformity, the caries is so extensive and the pus so abundant, that it escapes between the vertebræ, forming an abscess external to them, which connects with the interior of the vertebræ by a fistulous canal. This abscess if in the cervical region may press upon the pharynx or œsophagus, or upon the air-passages, producing dangerous obstruction to the respiration. (See Art. Retro-pharyngeal Abscess.) The pus may point and discharge externally near the seat of the caries, but in a large proportion of instances it takes a long and circuitous route to the surface, or it opens internally. There are instances in which it discharges into the pleural or abdominal cavity, or into one of the abdominal organs. If, as is sometimes the case, it establishes a connection with the intestine and escape in the stools, the result will probably be favorable. In other instances it descends into the pelvic cavity, and finds an outlet by the inguinal ring, or sciatic notch, or it enters the sheath of the iliacus or psoas muscle, and points externally.

When the disease ends favorably, new bone is thrown out around the diseased vertebræ, preventing further bending, and giving stability to the spine. If the abscess do not discharge, but remain subcutaneous, Billroth says: . . . "While the bone disease recovers most frequently, a large part of the pus, whose cells disintegrate into fine molecules, is absorbed, while the inner walls of the abscess change to a cicatricial tissue, which in the shape of a fibrous sac contains the puriform fluid. Such pus-sacs often remain in this stage for years."

If the pus have escaped externally, the abscesses and fistulæ contract and finally close, their site being occupied by condensed connective tissue. The portions of the diseased vertebræ which have retained their vitality are enveloped and supported by the new bone, so that the part of the spine which was the seat of the disease, though anchylosed and curved, has greater firmness than in health.

The history of unfavorable cases varies; the caries may extend. Pus finding no vent may accumulate in cavities and sinuses, in which detached portions of bone float, or it may make its way in such directions

that it produces alarming complications, and impairs or obstructs the functions of important organs.

Spinal meningitis in the vicinity of the caries, and due to extension of the inflammation, is common, and "the spinal medulla," says Billroth, "may be endangered by participation in the suppuration, or by being so bent by the inclination of the vertebræ, that its function is destroyed." Hence the paralysis of the lower extremities, bladder, and rectum, which occurs in aggravated cases, and which entails a fatal issue. In a certain proportion of cases the blood becomes more and more impoverished from the continuance of the inflammation and suppuration, and death occurs in a state of exhaustion. In such cases post-mortem examination often discloses waxy degeneration of important organs, as the spleen, liver, kidneys, and intestines, for it is well known that chronic suppurative inflammation of the bones is one of the two chief causes of the waxy disease, syphilis being the other.

Symptoms.—Caries of the vertebræ is often preceded by symptoms or appearances which are due to the strumous cachexia. Strumous ailments have probably occurred in the patient, or in members of the family, or without any clear history of struma the child has perhaps for some time been in failing health. In cases which I have observed, one of the chief symptoms, and sometimes almost the only symptom in the commencement of the caries, has been neuralgic pain, usually not severe, intermittent, or more or less constant, at some point in the anterior aspect of the body, most frequently in the chest, epigastric, or umbilical region. This pain has been present in a larger proportion of cases, than pain in the spinal region at the seat of the caries, though Guersant dwells particularly upon the latter as a symptom of caries. Patients with this neuralgia are not infrequently treated for indigestion, or worms, the true nature of the malady not being suspected, and the spine not even being examined. This neuralgia seems to be due to compression of the spinal nerves, by inflammatory exudation at the points where they emerge from the spinal canal. I can recall to mind a number of cases in which I have on different occasions been asked to prescribe for this neuralgia, which was shown by the sequel to be undoubtedly the result of vertebral caries, and yet with a careful examination of the spinal column could discover no evidences of disease at any point. After a time, tenderness, pain, and inflammatory induration, appreciable to the touch, may occur in or along the spine, but not usually till the malady is well advanced. Lassitude, fatigue after slight exertion, poor appetite, with slight fever, are common symptoms in the first stage of the caries.

As the case advances, if the nature of the disease be not recognized, and no artificial support of the trunk be provided, the child instinctively seeks some way of supporting the head and shoulders. He rests his head upon his hands, or his elbows upon the table. Soon a gibbosity or angularity appears, affording clear and positive proof of the nature of the disease. Even now there is little or no tenderness when pressure is made directly on the spine, but it is observed more when pressure is made laterally upon it. If the inflammation extend so as to involve the meninges and the cord, pricking, tingling, numbness or weakness of the legs may occur, which are symptoms of grave import,

for it is probable that the case will end in paraplegia and death. A state of emaciation and general weakness, sometimes accompanied by diarrhœa and œdema of the limbs, precedes death. But a very considerable degree of curvature is not incompatible with a healthy and normal performance of all the functions, and the number who recover, and live to an advanced age with deformity, is large, as every one knows.

Diagnosis.—This is often from the nature of the disease obscure and uncertain for a time. The long continuance of pain in the chest or abdomen, or perhaps in the thighs, without any cause which we can detect, located at the seat of the pain, should excite suspicion of spinal disease. Such pain may be produced by spinal irritation, but in this malady pressure on the spine is badly tolerated, and when we touch a certain part, the neuralgic pain is intensified. In caries, as we have seen, firm pressure upon the spine is tolerated, and it does not increase the neuralgia. At a later period in caries there may be spinal pain and tenderness, but there is now also spinal deformity, by which alone the diagnosis is clearly established; stiffness observed in the movements of the spine, pain in the spine, on sudden movement or jarring the body, impaired appetite and general health, and instinctive desire to sit or recline in such a way as to relieve the spine partially of the weight of the head and shoulders, are symptoms which, if they coexist, afford very strong evidence of the presence of caries, although there be as yet no deformity.

The spinal deformity of rachitis is distinguished from that of caries, by the fact that it occurs slowly without pain or tenderness, and is rounded instead of angular. Moreover, the rachitic diathesis precludes scrofulous ailments, and the scrofulous diathesis rachitic ailments, as the two diatheses do not coexist, or but rarely; so that if there be in the state of the patient or have been in his history evidences of scrofula, the presumption is that the bending of the spine occurs from caries. In a case of rachitic curvature, we find also enlargements of the ankles and wrists, keel-shaped thorax, prominent abdomen, rachitic head, etc.

Prognosis.—The course of this malady, even when the caries is slight and the symptoms mild, is tedious. In the most favorable cases the general health is but slightly impaired, the caries is confined to one vertebra, and is early diagnosticated and properly treated. On the other hand, if the general health be decidedly poor, the child anæmic and wasted, the curvature great, and an abscess have occurred, the case is very serious. Between these two extremes is every grade. The prognosis is more favorable in the child than in the adult. The few adults whom I have seen with it all died. It is less favorable in the cervical region than in the dorsal or lumbar. A mild case occurring in a good condition of health may become grave and even fatal by neglect and improper treatment. A majority of the patients, if the disease be not too far advanced when recognized, recover if properly treated, but the deformity which results may prove serious in after-life. The incomplete expansion of the lungs in the humpbacked, greatly increases the danger and the dyspnœa in bronchitis and pneumonia, and if the caries have been at a low point in the spine, and the patient a female, the deformity will probably present an obstacle to childbearing.

TREATMENT.—The treatment must be constitutional and local, hygienic, medicinal, and mechanical. It is of the utmost importance to improve the general health, as it is in all chronic inflammations and scrofulous ailments. Pure air, sunlight, personal cleanliness, and plain but the most nutritious diet are required. Tonic and antistrumous remedies are indicated. To many patients I have prescribed, three times daily, cod-liver oil, to which the syrup of the iodide of iron was added, giving two drops to a child of one year, and one additional drop for each additional year. The judicious use of alcoholic stimulants will often be found useful, if the appetite be poor and general health seriously impaired, as will also the vegetable bitters.

In all strumous inflammations of the bones, which extend to or involve joints, and which are in their nature chronic, perfect quiet of the parts, so far as it is consistent with the degree of exercise which is required in order to improve the appetite and general health, is indispensable for successful treatment of the case. The patient with this malady should be encouraged to lie much of the time in bed, for the double purpose of preventing movements of the inflamed vertebræ, and relieving them of the weight of the shoulders and head. But confinement in bed is badly tolerated, and exercise is necessary for a healthy functional activity of the organs; therefore mechanical support of the spine is required. The apparatuses which have been invented for the purpose of supporting the spine and rendering it immovable, and of sustaining the head, if the caries be in the cervical region, or the head and shoulders, if it be in the dorsal or lumbar region, are ingenious and effectual. Some of them are rather cumbersome, but others are sufficiently light for the youngest child who can walk. The apparatus should be worn for months, care being taken to prevent excoriation or undue pressure upon any point. It may be removed at night, and reapplied on rising in the morning.

SECTION II.

DISEASES OF THE RESPIRATORY SYSTEM.

CHAPTER I.

CORYZA.

The term coryza is applied to inflammation of the Schneiderian membrane. It is acute or chronic. The acute form is primary or secondary. Acute primary coryza is common in infancy and childhood. Its usual cause is exposure to currents of air, to cold, and especially to sudden changes of temperature from warm to cold. The cause is the same as that in the ordinary forms of bronchitis. These two diseases frequently indeed coexist, occurring from the same exposure. The inflammation in such cases commences upon the Schneiderian membrane, immediately upon the operation of the cause, and soon after extends to the bronchial tubes. Acute coryza may also be produced by the inhalation of irritating vapors, hot air, or dust, and also by the presence of a foreign body, as a button or bean, in the nostril.

Secondary coryza is commonly due to a specific cause. The diseases in connection with which it occurs are hooping-cough, measles, scarlet fever, diphtheria, and constitutional syphilis. In the infant, coryza is one of the first manifestations of hereditary syphilitic taint.

Acute primary coryza ordinarily abates in from one to two weeks. The secondary form gradually declines, in most cases, when the primary affection on which it depends is cured. Syphilitic coryza is more protracted than the primary form, or than that accompanying the eruptive fevers. Some children are so liable to coryza that it occurs whenever they take cold. Occasionally it is so frequently renewed in the winter months that it resembles the chronic form of the disease.

Chronic coryza is commonly dependent on a dyscrasia, usually the syphilitic or strumous. The dyscrasia is indicated by pallor, flabbiness of the flesh, and liability to glandular swellings. Certain cases take their origin in the nasal catarrh of the exanthematic fevers, the local affection continuing after the constitutional disease has declined. Chronic coryza sometimes occurs in children who appear otherwise in good health. It is probable that in such cases there is a dyscrasia of which the coryza happens to be the sole manifestation.

Anatomical Characters.—The alterations which the nasal mucous membrane undergoes when inflamed vary considerably in different cases. In the simplest and most common form of coryza, this membrane is sometimes in patches, sometimes generally reddened, thickened, and softened. Its papillæ are prominent, producing an inequality of the surface. Ulcerations are not common in simple acute coryza, but they sometimes occur in the chronic form.

In diphtheria, and sometimes in scarlet fever and variola of severe type, the coryza is pseudo-membranous, and when it presents this form it is commonly but not always associated with pseudo-membranous angina or laryngitis. A case of pseudo-membranous coryza occurring in measles is related by M. Guibert. The patient was a rachitic boy, three and a half years old. The pseudo-membrane, in grave cases, may cover almost the entire surface of the nostrils, but ordinarily it occurs in patches.

Symptoms.—The constitutional symptoms are mild or severe, according to the gravity of the inflammation. If the coryza be acute and pretty general, there is febrile movement, with thirst and loss of appetite. Frontal headache is common, from the proximity of the inflammation to the head, or its extension to the frontal sinuses. Sneezing is the first symptom in many cases of acute coryza. As the inflamed membrane swells, more or less obstruction occurs to respiration. The breathing is noisy, especially during sleep, and in severe cases the patient is compelled to breathe mostly through the mouth. If there be much obstruction to respiration the suffering of the patient is considerable, from the sensation of fulness in the nostrils, the headache, and the muscular effort required in each respiratory act.

In the commencement of coryza the patient experiences a sensation of dryness in the nostrils, which is soon succeeded by a thin discharge of a serous appearance. In the course of a few hours the secretion becomes thicker. It is muco-purulent, and remains such till the disease begins to decline. Inspissated mucus and crusts are liable to collect within the nostrils and around their orifice in chronic coryza, and sometimes also in the acute disease, if the discharge be not abundant. These crusts increase the difficulty of breathing. Often the acridity of the discharge is such that the skin of the upper lip and around the nostrils is excoriated.

Prognosis—Uncomplicated catarrhal coryza rarely terminates fatally. It is only dangerous in young nursing infants, in whom it may seriously interfere with lactation. Coryza, accompanying the eruptive fevers, although it may increase the suffering, does not materially increase the danger. Syphilitic coryza subsides when the system is sufficiently affected by antisyphilitic remedies. Chronic coryza is sometimes very obstinate. It may continue for months or years, giving rise to a constant, but often not abundant, discharge.

Treatment.—Common mild attacks of coryza require little treatment. The bowels should be kept open, the feet soaked in mustard-water, and the body should be warmly clothed. Inunction of the nostrils is a popular remedy, and it seems to give some relief. If coryza commence with symptoms which indicate a pretty severe attack, and

there are evidences of extension of the disease toward the bronchial tubes, an emetic of syrup of ipecacuanha, given at an early period, moderates the severity of the inflammation and may prevent the occurrence of bronchitis. Afterward a simple diaphoretic mixture, as the following, should be given:

℞.—Syrupi ipecacuanha . . . . . ℥ij.
Spirit. æther. nitr. . . . . ℥j.
Syrupi simplicis . . . . . ℥ij.—Misce.

One teaspoonful every three hours to a child of six months. In place of sweet spirits of nitre, acetate of potassium may be employed in the dose of one or two grains for infants; and if there be decided febrile reaction, from half a minim to two minims, according to the age, of tincture of digitalis, should be added to each dose.

A three to five per cent. solution of common salt in warm water injected into the nostrils with a small syringe, aids materially in removing the muco-pus which obstructs the respiration, and in establishing a healthier state of the inflamed surface. I have employed in the same way, with apparent benefit, carbolic acid, glycerine and water, to which the borate of sodium or a few grains of chlorate of potassium have been added. This may also be conveniently used in the form of spray, with the steam atomizer, or thrown up the nostrils with the hand atomizer. The officinal lime-water is also a most useful detergent of the nasal surface. The following formula will be found useful in most cases of this form of coryza. It should be injected warm several times daily:

℞.—Sodii chloridii . . . . . ℥j.
Sodii borat. . . . . ℥ij.
Aquæ . . . . . Oj.—Misce.

The treatment proper for pseudo-membranous or diphtheritic coryza is detailed in our remarks on the therapeutics of diphtheria. Chronic coryza, since it depends upon a dyscrasia, of which it is one of the local manifestations, requires remedies appropriate for the blood disease. Scrofula needs the syrup of the iodide of iron and cod-liver oil. The various ferruginous preparations, as wine of iron, tincture of the chloride of iron, iron lozenges, and the vegetable tonics are also more or less useful. The diet should be nutritious and plain, and outdoor exercise, and, if possible, country life, should be enjoined.

If the dyscrasia be syphilitic, similar invigorating measures are required, and mild mercurial inunctions to the nasal surface are especially useful. The following, which has been largely employed in the Outdoor Department at Bellevue, is one of the best ointments for such cases, and its alterative effect renders it also useful for strumous coryza:

℞.—Ung. hydrarg. nitratis . . . . . ℥ij.
Ung. zinci oxid. . . . . ℥ij.—Misce.

To be thoroughly applied to the Schneiderian membrane by a swab or camel's-hair pencil three or four times daily. Recently it has been modified by the substitution of Squibb's five per cent. oleate of mercury

in place of the citrine ointment. If the coryza have a distinctly syphilitic origin, the application of a two or three per cent. oleate of mercury will fully meet the indication and be followed by improvement.

Meigs and Pepper recommend the following ointment in chronic coryza, to be applied at night, after the use of injections through the day:

℞.—Unguenti hydrargyri nitratis . . . . . ʒss.
Extracti belladonnæ . . . . . gr. x.
Axungiæ . . . . . ʒss.—Misce.

Astringent injections into the nostrils are not often required in the treatment of the various forms of coryza; but occasionally, if the discharge be protracted and abundant, weak astringent applications may be beneficial, as two or three grains of nitrate of silver, or of alum or tannin, to the ounce of water. It should be borne in mind that washes for the nasal surface should, as a rule, be employed tepid.

CHAPTER II.

CATARRHAL LARYNGITIS.

Acute catarrhal laryngitis occurs at all ages, but it is so common in infancy and childhood, that it is proper to treat of it in a work relating to the diseases of these periods. Like other inflammatory affections of the air-passages, it is most common in the cold months, or when the weather is changeable. Its usual cause is, therefore, exposure to cold. Protracted and violent crying, and the inhalation of acrid vapors are occasional causes. Catarrhal, or as it is sometimes designated simple laryngitis, also occurs in connection with certain constitutional diseases, among which may be mentioned measles, scarlatina, and variola. Laryngitis is also a common accompaniment of bronchitis, and not infrequently of pneumonitis, though its symptoms are liable to be obscured by those of the graver disease. It often likewise accompanies pharyngitis, due to extension of the inflammation.

Symptoms.—Catarrhal laryngitis produced by the impression of cold, is commonly preceded and accompanied by coryza. The initial symptom is chilliness, followed by sneezing, and the discharge of thin mucus from the nostrils in consequence of irritation of the Schneiderian membrane.

The commencement of laryngitis is indicated by hoarseness, which is apparent when the child cries, or, if old enough, when it attempts to speak. There is often in severe cases complete loss of voice, so that speech above a whisper is impossible. I have noticed this most frequently in the laryngitis which accompanies measles. A cough occurs

which is at first dry and husky but becomes loose in the course of a few days. Expectoration is scanty, unless the inflammation have extended to the trachea and bronchial tubes.

This disease is often accompanied by soreness of the throat, noticed in the act of coughing or when the larynx is pressed with the finger. In laryngeal catarrh, when uncomplicated, the respiration remains nearly natural and the pulse is but little accelerated. In mild cases the nature of the disease is often not apparent as long as the child remains quiet, in consequence of the absence of symptoms, but the character of the voice when it cries or speaks, or of the cough, reveals at once the nature of the affection.

Acute laryngeal catarrh subsides in from one to two weeks. Occasionally it lasts three or four weeks before the symptoms entirely disappear. Death, which is rare, is due to some complication.

Chronic laryngitis is much less frequent than the acute form. Its anatomical characters are similar to those in other chronic inflammations affecting mucous surfaces, to wit. thickening and more or less infiltration of the mucous membrane, increased proliferation and exfoliation of the epithelial cells, and increased functional activity of the muciparous follicles.

In the adult, chronic laryngitis is common as one of the lesions of the syphilitic or tubercular disease. In the child syphilitic and tubercular laryngitis is more rare, but the latter sometimes occurs in connection with pulmonary or bronchial tuberculosis. Such patients are emaciated, and have the ordinary symptoms of the tubercular disease. Chronic laryngitis also occurs in young children, usually infants, as one of the manifestations of the strumous diathesis. I have records of several such cases, mostly nursing infants. Some of these patients had mild bronchitis, but it was obviously subordinate to the laryngitis. Their respiration was noisy and harsh, continuing of this character for several weeks and even months. The cough was also harsh and loud, conveying the idea of thickening and relaxation of the mucous membrane covering the vocal cords. Their respiration was not notably accelerated, and the blood was apparently fully oxygenated, though the friends were often alarmed by the noisy breathing and cough.

In this form of chronic laryngitis expectoration is scanty, the fever slight or absent, the appetite remains unimpaired, and the general condition of the child is good. From time to time exacerbations occur, and occasionally improvement is such as to encourage the hope of speedy cure, but in the cases which I have seen there has not been complete intermission in the disease till the final recovery. Those patients whom I have been able to follow through the disease have recovered in from three or four months to one year.

Chronic laryngitis is to be distinguished from frequent attacks of acute laryngitis, which are due to fresh exposures, and also from the laryngitis which is associated with bronchial phthisis. It is to be distinguished from protracted acute laryngitis, which sometimes does not entirely subside in less than a month or six weeks, by its longer duration, the greater thickening of the inflamed membrane, and more noisy respiration. Often chronic laryngitis results from the acute disease,

the inflammation being perpetuated by the struma or dyscrasia of the patients.

Anatomical Characters.—In acute catarrhal laryngitis the mucous membrane of the larynx presents the usual appearances of mucous surfaces when inflamed, namely, redness and thickening. It is also more or less softened. Ulcerations rarely, perhaps never, occur in primary acute laryngitis. When present in chronic laryngitis, the ulcers are small and situated upon or near the vocal cords. Tubercular and syphilitic ulcers of the larynx are much more rare in children than in adults. The inflammation in simple acute laryngitis usually extends over the whole surface of the larynx, and also to the upper part of the trachea. It may be pretty uniform, or more intense in one place than another, and, like other mucous inflammations, it is accompanied by more or less proliferation and exfoliation of epithelial cells. In most cases of simple laryngitis, whether acute or chronic, the inflammation extends to the pharynx, producing redness and thickening, though generally moderate, of the mucous membrane which covers it. Examination of the fauces therefore aids in diagnosis.

In the adult œdema glottidis occasionally results from laryngitis. In the child there is little danger that this will occur, in consequence of the anatomical character of the larynx, since in early life the larynx contains but little submucous connective tissue, and therefore less submucous infiltration or effusion occurs during the inflammation. The structural changes occurring in catarrhal laryngitis of infancy and childhood relate almost exclusively to the mucous membrane.

Treatment.—Primary and uncomplicated catarrhal laryngitis requires little treatment. Most cases do well by the employment of suitable hygienic measures, without medicines. Benefit is, however, derived from the use of demulcent drinks and an occasional laxative. A mixture of paregoric and syrup of ipecacuanha, or the mist. glycyr. comp., or a small Dover's powder, will relieve the cough. For restlessness, a warm foot-bath is also useful. Inhalation of the spray of glycerine and water from the atomizer, or of steam, plain or medicated, is also useful. Mildly stimulating embrocations, as by camphorated oil with or without a little turpentine, also aid. It should be rubbed several times daily over the throat, or a strip of flannel soaked with it may be applied around the neck. Chronic laryngitis dependent on syphilis or tuberculosis requires the constitutional treatment which is appropriate for that disease. Measures not specific have little effect upon this form of inflammation. The chronic laryngitis which I have described as occurring chiefly in infancy, and which appears to be of a strumous character, is in most cases obstinate. The patient should be warmly clothed, and constant care should be taken that there be no exposure which would endanger taking cold, as this would produce an exacerbation of the disease, and tend to counteract what had been gained by remedial measures. This form of chronic laryngitis is most satisfactorily treated by the application of tincture of iodine upon the neck, directly over the larynx, and the internal use of cod-liver oil and the syrup of the iodide of iron. No benefit results in this inflammation from expectorant remedies, as squills or senega.

Spasmodic Laryngitis.

This is a common disease. It is also called false croup, in contradistinction to true or pseudo-membranous croup, and, by some continental writers, stridulous angina or stridulous laryngitis. It should not be confounded with spasm of the glottis, which is a form of internal convulsions, and is not inflammatory. It occurs ordinarily between the ages of two and five years. It is commonly a sporadic affection, but Rilliet and Barthez state that "it is incontestable that it may prevail epidemically." They express this opinion, not from their own observations, but chiefly from those of Jurine, made in the commencement of the present century.

Causes.—Children in some families are more liable to false croup than in others, so that an hereditary tendency to it must be admitted. The exciting cause in most cases is exposure to cold. False croup is not uncommon in the commencement of measles. Narrowness of the rima glottidis, and an excitable state of the nervous system, both of which are common in early childhood, are predisposing causes.

Symptoms.—Spasmodic laryngitis is ordinarily preceded for a day or two by a slight cough and fever, by symptoms of mild nasal catarrh, such as all children are liable to on taking cold. In exceptional cases these symptoms are absent and the disease begins abruptly. Singularly, it commences in most patients at night, after the first sleep, between ten and twelve o'clock. The sleep is usually quiet and natural, but the child awakens with a loud, barking cough. There is great dyspnœa, and the respiration is harsh or whistling, on account of the narrowing of the chink of the glottis from the swelling and tension of the vocal cords. The face is flushed and expressive of suffering. The child cries, moves from one position to another, wishes to be held or carried, seeking in vain for relief. The skin is hot, pulse accelerated, the voice hoarse or even whispering. After a variable period, usually from half an hour to two or three—not more than half an hour with proper treatment—these symptoms abate. The patient is then somewhat exhausted and falls asleep. The face is less flushed or even pallid, the heat abates, and the pulse is less accelerated. The cough, though less frequent, remains for a time barking or sonorous, and respiration, though greatly relieved, is not at once entirely natural, but it gradually becomes so. In many cases the spasmodic respiration and cough do not recur, but sometimes the attack is repeated once or more, especially during the subsequent nights. The symptoms vary greatly in intensity in different patients.

As the attack declines, the disease, losing its spasmodic character, becomes a simple inflammation. In some patients the abatement of the cough and restoration of health are rapid, but oftener the inflammation extends not only into the trachea, but also into the larger bronchial tubes, and a tracheo-bronchitis remains, which gradually declines.

The termination is not always so favorable. Spasmodic laryngitis is, in exceptional instances, the precursor of other serious affections, which may prove fatal. It has been stated that measles often begins with

spasmodic laryngitis. Bronchitis becoming capillary, may occur in connection with it, as may also pneumonia, and by either of these severe inflammations the prognosis may be rendered doubtful. A few cases have been recorded in which it was believed that spasmodic laryngitis was of itself fatal. In some of these the dyspnœa was extreme and persistent, and was the cause of death. In a case reported by Rogery, on the other hand, the respiration became easy before death, and the pulse more and more frequent and feeble. Death apparently occurred from exhaustion. It is not improbable that, had careful post-mortem examinations been made in those cases of spasmodic laryngitis which have ended fatally, other lesions would have been discovered besides those located in the larynx, perhaps tracheo-bronchitis, with an accumulation of mucus in the larynx, producing suffocation, or perhaps in some of the cases congestion of the brain or lungs and serous effusion.

Anatomical Characters—Pathology.—The opportunity does not often occur of determining the anatomical characters of spasmodic laryngitis. I have witnessed but one post-mortem examination. A little girl, nine years old, was taken on Friday night with cough and dyspnœa, indicating a pretty severe attack. The mother, acting through the advice of a friend, gave kerosene oil to her in considerable quantity. This was succeeded by obstinate vomiting and purging, which continued during Saturday and Sunday, and terminated fatally on Monday. At the autopsy we found uniform and intense injection throughout the whole extent of the larynx and trachea and in the bronchial tubes, but there was no pseudo-membrane on the inflamed surface, and but little mucus and pus. The solitary follicles of the intestines and Peyer's patches were tumefied, and the gastro-intestinal surface was injected in places. The cause of death was obviously the diarrhœa, apparently of an inflammatory character, and probably produced by the kerosene oil. The condition of the mucous membrane of the larynx was that which is ordinarily present in spasmodic laryngitis, though in some cases in which post-mortem examinations have been made the evidences of laryngeal inflammation were slight. Guersant relates a case in which the surface of the larynx seemed to be nearly in its normal state. Death in cases of slight laryngitis is due to causes which are independent of the larynx. In Guersant's case tuberculosis was present.

There is, as has already been intimated, another and a more important element besides the inflammation in the pathology of spasmodic laryngitis—an element producing those phenomena which render it a disease distinct from simple laryngitis. I refer to spasm of the laryngeal muscles. This element pertains to the nervous system, so that spasmodic laryngitis is allied both to the neuroses and to inflammation.

Diagnosis.—The disease for which spasmodic laryngitis is most frequently mistaken is pseudo-membranous croup. The friends, indeed, usually make this mistake in forming their opinion of the case before the physician arrives; and there can be no doubt that many of the cases which have been published in medical journals as true croup were examples of this affection. The points of differential diagnosis are the following: True croup begins with symptoms which at first are slight, so as scarcely to arrest attention, but which gradually increase

in intensity. The cough becomes more harsh, and the respiration more difficult, by degrees. This increase in the gravity of the symptoms occurs by day as well as by night. On the other hand, false croup, though preceded by symptoms of nasal catarrh, commences abruptly. The symptoms have from the first their maximum intensity, and the time at which it commences is at night. Again, the cough in spasmodic laryngitis possesses a loud, sonorous character; while in true croup it is harsh or rough, from the presence of the membrane, and having, therefore, less fulness. The voice in spasmodic laryngitis may be hoarse, but it is not lost, or is lost only for a short time. It afterward becomes natural, or is slightly hoarse. On the other hand, in true croup, the voice, from being natural at first, is gradually extinguished. In fatal cases it soon becomes whispering, and continues such till the close of life; in those that recover, the voice remains hoarse for several days. These differences are important, and, if fully appreciated, are in most instances sufficient to establish the diagnosis. Besides, in a large proportion of cases of true croup, portions of the pseudo-membrane may be discovered on inspecting the fauces, and the faucial surface is deeply injected, while in spasmodic laryngitis there is, with rare exceptions, no false membrane upon the surface of the fauces, and but a moderate amount of congestion.

Laryngismus stridulus, or internal convulsions, must not be confounded with this disease. It is not inflammatory, but purely spasmodic, suddenly commencing and abating—identical, it is believed, in character with tonic convulsions of the external muscles, but affecting the internal muscles of respiration. This disease has already been fully described.

Prognosis.—Little need be added, as regards prognosis, to what has already been stated. While a favorable opinion in reference to the result may ordinarily be expressed, the physician should not forget the fact that death may occur. Symptoms indicating an unfavorable termination are: great and continued dyspnœa, not diminished by the proper remedial measures; stridulous expiration as well as inspiration; lividity of the prolabia and fingers; pallor and coldness of surface; pulse progressively more frequent and feeble. Convulsions and coma may also occur near the close of life.

Treatment.—The indications of treatment are twofold: first, to relieve the spasmodic action of the laryngeal muscles; secondly, to cure the laryngitis. To meet the first indication, a warm bath of the temperature of about 100° should be employed as soon as possible after the commencement of the attack. The patient should be kept in it ten or fifteen minutes, in order to obtain its full relaxing effect. In mild cases a warm foot-bath may be sufficient. A second means is the use of an emetic, which should be simultaneous with the bath. To children under the age of three years, syrup of ipecacuanha should be given, in doses of one teaspoonful, repeated in twenty minutes, till vomiting occurs; or alum and syrup of ipecacuanha, two drachms of the former to one ounce of the latter, may be given in the same dose. The alum and the syrup produce more prompt emesis than the syrup alone. Children over the age of three years, unless of feeble constitutions, are best treated by the

compound syrup of squills in teaspoonful doses, or a mixture of this with syrup of ipecacuanha. It is not often necessary to give more than three or four doses, and sometimes one or two are sufficient to produce vomiting.

In most cases, by the use of the warm bath and the emetic, the symptoms are rendered milder, and convalescence soon commences.

Dr. R. R. Livingstone[1] reports a case of laryngitis treated by Squibb's ether. It is stated that portions of pseudo-membrane, from one-eighth to three-fourths of an inch in length, were expectorated; but the symptoms certainly indicated a spasmodic element as decided as in spasmodic croup, and the benefit from the ether was apparently due to the relaxation of the laryngeal muscles which it produced. The treatment of the patient, who was two years old, was commenced by the administration by the mouth of half a teaspoonful of the ether, and followed by its inhalation. "In precisely eight minutes from the time the patient commenced the inhalation, the abnormal muscular exertion ceased; a general relaxation took place; the pulse (which had numbered 150) fell to 100." Ether, judiciously employed, will probably prove to be a useful remedial agent in spasmodic forms of laryngitis, whether or not it have any effect on pseudo-membranous formations. A large majority of cases, however, recover speedily without its employment, or by the other measures recommended.

Attention should always be given to the state of the bowels in spasmodic laryngitis; if they are not well open, a purgative should be administered. For those that are robust, and with considerable febrile movement, the saline cathartics are ordinarily preferable, as Rochelle salts, or a purgative dose of calomel may be administered. The cathartic should not be prescribed till the nausea from the emetic has subsided. By its derivative effect, it tends to diminish the laryngitis, and, in severe cases, it may obviate the need of depletion by leeches.

Inhalation of the vapor of hot water, and the application of a sinapism over the neck and upper part of the sternum, followed by an emollient poultice, are useful adjuvants to treatment.

The most convenient and effectual way of employing vapor is, however, by the atomizer, and as the chief danger is that the inflammation may become pseudo-membranous, I am in the habit of using in the atomizer the officinal lime-water.

When the spasmodic element in the disease is relieved, the case becomes one of simple laryngitis, and the general plan of treatment recommended for that malady is proper for this. Small doses of ipecacuanha, or of one of the antimonial preparations, as the compound syrup of squills, not sufficient to cause nausea, should now be given at regular intervals. I have sometimes added to the expectorant one drop of the tincture of aconite root for robust children over the age of three or four years, having a full and rapid pulse, flushed face, and other evidences of active febrile movement. Its effect should be watched, and it should be discontinued when its sedative influence on the circulation begins to

[1] American Journal of the Medical Sciences, April, 1867.

be apparent. It should not be given in the spasmodic laryngitis which occurs in the commencement of measles.

If, however, the disease do not speedily terminate by recovery of the patient, or, more rarely, by death, there is nearly always tracheo-bronchitis, or a more serious affection, coexisting with the laryngitis, or following it, so that depressing measures should not be long continued. Expectorants of a stimulating character, as carbonate of ammonium, or syrup of senega, are required in the course of a few days, and in young and feeble children they should be given at an early period.

The mode of treatment recommended above is appropriate for that large class in whom the inflammatory element predominates. In a smaller number of cases the nervous element predominates over the inflammatory, and the treatment should be in some respects different. Such children are usually pallid and of spare habit, having, indeed, the nervous temperament. They are liable to attacks of this disease, though generally of a mild form, on slight exposure to cold, and with a very moderate amount of inflammation. The treatment in these cases should be directed more to the nervous system. My plan has been, in the treatment of such patients, after perhaps the use of a mild emetic, to give quinine, one grain three or four times daily, to a child from three to five years old, prescribing at the same time a simple expectorant, as syrup of squills, and a mildly irritating application to the throat. The symptoms in these cases are not severe, and active measures are not required, though the peculiar cough continues longer than in the more inflammatory forms of the malady.

The patient with spasmodic laryngitis should be kept in a warm room during the paroxysms, and should inhale an atmosphere loaded with moisture.

Trousseau recommends a mode of treatment of spasmodic laryngitis which was first suggested by Graves, of Dublin. It consists in the application underneath the chin, so as to cover the larynx, of a sponge soaked in water as hot as can be borne; in ten or fifteen minutes it is repeated. This reddens the skin, producing revulsion from the larynx. The hoarseness, dyspnœa, and cough diminish with this treatment, and some recover without other measures.

Guersant and others speak of the importance of prophylactic management of children who are liable to this disease. Attention should be given to the dress, so that there may be sufficient protection from atmospheric changes, and there should be an equable temperature of the apartments in which they reside. Children of a decidedly nervous temperament, in whom the slightest laryngitis is liable to be spasmodic, require additional prophylactic measures. They are pallid, and in a more or less cachectic state. Such children are benefited by chalybeate and vegetable tonics, and by exercise in suitable weather in the open air.

CHAPTER III.

MEMBRANOUS CROUP; DIPHTHERITIC CROUP; TRUE CROUP.

The term pseudo-membranous laryngitis, or laryngo-tracheitis, or true croup, is applied to a common and fatal disease, the essential anatomical character of which is inflammation of the larynx, or larynx and trachea, with the formation of a pseudo-membrane upon its surface. It occurs most frequently between the ages of two and twelve years, but infancy after the age of six months and early manhood are not exempt from it. For brevity I shall use the term croup in the following pages to indicate this form of inflammation, although recognizing another form of croup, the spasmodic or catarrhal, in which no pseudo-membrane occurs.

Etiology.—Wherever diphtheria prevails as an endemic or epidemic, it is well known that a large majority of the cases of membranous croup are local manifestations of this disease, and this inflammation is therefore in such localities commonly designated diphtheritic croup. Physicians have endeavored to discriminate between croup due to diphtheria and that from other causes; but whatever the cause, the anatomical characters, the clinical history, and the required treatment are so nearly identical that attempts to differentiate the disease when produced by other agencies than diphtheria from that due to diphtheria, have proved futile and unsatisfactory in localities where diphtheria occurs, except in a few instances, as, for example, when croup has been manifestly caused by swallowing or inhaling some irritating agent.

Inflammation of the laryngeal and tracheal surface, whatever its cause, whenever it reaches a certain grade of severity, may be attended by the exudation of fibrin and the formation of a pseudo-membrane, but such a result more frequently occurs in the inflammation caused by diphtheria than in that produced by other agencies. In diphtheria a moderate laryngo-tracheitis is attended by the pseudo-membranous formation.

The percentage of cases of diphtheria in which the larynx becomes implicated and croup occurs, varies in different epidemics and in different seasons and localities. In epidemics of a mild type, the cases appear to be fewer in which the larynx is involved than in epidemics of a severe form. In New York the percentage is large. From December 1, 1875, to July, 1878, I preserved records of all the cases of diphtheria which came under my notice. The number was 104, and in twenty-five of these, or about one in four, croup occurred, producing the usual obstructive symptoms, and constituting the chief source of danger. During the two and a half years embraced in these statistics the disease was usually severe. In the last five years amelioration has occurred in the type of diphtheria in this city, and the proportion of croup cases has not been so large.

So commonly is membranous croup, when occurring in a locality where diphtheria is endemic or epidemic, a local manifestation of diphtheria, that physicians in such localities come to regard every case of this disease of the larynx as produced by the diphtheritic poison. In New York physicians scarcely recognize any other form of membranous croup. It is well, therefore, briefly to recall the evidences that croup in a certain proportion of cases results from other causes than diphtheria. The occurrence of croup in localities where diphtheria is unknown, of course, indicates the operation of some other agency than the diphtheritic poison. Thus, in 1842, before diphtheria was established in this country, Dr. John Ware, of Boston, published his well-known paper on croup, and in 74 of the 75 cases embraced in his statistics the membranous exudation was present upon the faucial surface. The statistics relating to the introduction of diphtheria into New York City, and the recorded death statistics of this city, have been annually published, and each year more or fewer deaths from croup have been reported. The first death from diphtheria in this century, within the city limits, certified by a physician, was that of a German woman, at 638 Hudson Street, on February 15, 1852. Two other fatal cases occurred in 1857, and since then the deaths from croup and diphtheria have been as shown in the following table:

Year.	Croup.	Diphtheria.	Year.	Croup.	Diphtheria.
1858 . . .	478	5	1867 . . .	338	251
1859 . . .	622	53	1868 . . .	342	276
1860 . . .	599	422	1869 . . .	483	328
1861 . . .	460	453	1870 . . .	421	308
1862 . . .	685	594	1871 . . .	466	238
1863 . . .	908	981	1872 . . .	675	446
1864 . . .	754	781	1873 . . .	732	1151
1865 . . .	449	534	1874 . . .	594	1665
1866 . . .	368	435	1875 . . .	758	2329

Since 1875 weekly bulletins were issued, instead of the annual reports.

Thus, in the first years after the introduction of diphtheria, the deaths assigned to croup so greatly outnumbered those of diphtheria, as in 1858, when five died of diphtheria and four hundred and seventy-eight of croup, that it is evident that most of the cases of croup in those years were attributable to other causes than diphtheria. Since, as we have stated, any inflammation of the surface of the larynx and trachea; if sufficiently intense, may produce a pseudo-membrane, croup may occur as a primary disease, and as a complication of various maladies. According to my observations in New York City, the chief causes of croup, arranged in the order of frequency, would be about as follows: diphtheria, "taking cold," measles, pertussis, scarlatina, typhoid fever, irritating inhalations. I have, elsewhere, related cases of scarlet fever of severe type, in which a thin film of pseudo-membrane was found upon the surface of the larynx and trachea, and there was no other lesion to indicate that diphtheria had supervened. The croup was, to all appearances, caused by the scarlatinous and not the diphtheritic poison. The following was a case in which croup was apparently idiopathic, and pro-

duced by that common cause of inflammations of mucous surfaces, to wit, exposure to sudden atmospheric changes:

Case.—At midnight, on October 22, 1884, I was summoned to a child aged 25 months, who had been in the street till nearly nightfall, when the weather suddenly became much cooler, and he was brought home. At 11.45 P. M. he awoke with a harsh voice and croupy cough so as to alarm the family. I found the axillary temperature normal, but the fauces were injected, and the diagnosis was made of spasmodic or catarrhal croup. Emesis was produced by syrup of ipecacuanha; the croup kettle, and a mixture of potassium chlorate and ammonium chloride were ordered.

On the following day he walked around the room and seemed better, but the inhalation of the vapor of lime from the croup kettle was continued. At 7 P. M. the symptoms became aggravated, the cough was frequent and hoarse, temperature (axillary) 100½°, pulse 120, and respiration noisy. At my visit the post-clavicular, supra-sternal, infra-mammary, and epigastric regions were depressed in each inspiration, though only to a moderate degree; face flushed, fauces injected but without pseudo-membrane. The aspect was now more serious on account of the increasing dyspnœa. The pulse was strong, and no pseudo-membrane was visible; the temperature in the groin was scarcely 100°. Emesis had been produced before my arrival, and in the matter vomited was a pseudo-membrane with ragged edges, and about one-half an inch in length; examined within an hour subsequently under the microscope, it was found to consist of fibrillæ, evidently fibrinous, some of them wavy, and inclosing many pus-cells. Ten grains of calomel were placed on the tongue, and inhalations of the following were almost constantly employed by the steam atomizer:

℞.—Liq. potassæ . . . . . ℥ij.
Aq. calcis . . . . . ℥xij.—Misce.

On the following day the respiration was easier, and within twenty hours the patient had so far convalesced as to be out of danger. There had been no case of diphtheria in the house, nor recently, so far as I could learn, in the immediate neighborhood.

That this was a local disease, non-specific, and quite distinct from the croup of diphtheria, cannot, I think, be doubted.

In considering the etiology of croup, and recognizing diphtheria as by far its most common cause, wherever the latter disease prevails, an interesting theory is suggested, to which Heubner alludes, who affirms that inflammations, even with the characteristic membranous exudation, may be set up without the micrococci of diphtheria and then inoculation by micrococci occur, and "induce the general disease."[1] The point alluded to is that inflammations arising from other causes than diphtheria now and then become intensified, and rendered more protracted and dangerous by the reception of the diphtheritic virus after the inflammations are established. In support of this opinion it is well known by all who have had much experience with diphtheria, that those surfaces are prone to be attacked by the specific inflammation that are already irri-

[1] "Die experimentelle Diphtheria," Leipzig, 1883, quoted in Ziegler's Pathol. Anat., part. ii., paragraph 444, Wm. Wood & Co., 1884.

tated or inflamed when diphtheria is contracted. Hence the occurrence of the pseudo-membrane on recent wounds, upon the eyelids in cases of catarrhal conjunctivitis, upon the uterine surface after parturition, and upon the laryngeal, tracheal, and bronchial surfaces, if they are already inflamed as in measles.

Scarlatina is so often complicated by diphtheria that there seems to be a close affinity between the two diseases. It is a very common observation in New York City that scarlet fever continues two or three days, in its usual form, when the symptoms become suddenly aggravated and the aspect of the disease more severe. On inspecting the fauces a pseudo-membrane is discovered covering this region, and it probably appears also upon the nasal surface. Although severe scarlatinous inflammation may cause a fibrinous exudation, yet that diphtheria has supervened upon scarlet fever in a considerable proportion of cases which have the above history cannot, I think, be doubted. In a few instances in my practice (four) the fact that scarlet fever was complicated by true diphtheria, and the scarlatinous inflammations, first in order, were intensified by the presence and influence of the diphtheritic poison, was shown by the occurrence of diphtheria without scarlet fever in other members of the family.

In accordance with the above law, we may assume that a child who has laryngo-tracheitis, so common from taking cold and manifested by cough and hoarseness, is more prone to have diphtheritic croup than is one whose air-passages are in their normal state when diphtheria commences. A supposed error of diagnosis is often made by physicians, always to their discredit, who diagnosticate catarrhal laryngitis, but find, after two or three days, that their patients really have diphtheritic croup. A considerable number of such instances have come to my notice, always with the ill-will of families toward their physicians. Now it seems to me that in many of these cases the physicians have been right in their first diagnosis, and diphtheritic croup supervened on the catarrhal inflammation.

Another point relating to the etiology of diphtheritic croup requires notice. Many physicians, who have had ample opportunities to observe diphtheria, believe that the common way in which diphtheritic croup begins is as follows: The faucial or nasal surface is first affected, becoming covered by the pellicular exudation, and during inspiration particles of the pseudo-membrane, containing the specific principle, being detached, lodge in the larynx. At the point of inoculation the specific inflammation arises and extends. This may be the manner in which the croup of diphtheria begins in certain cases, but it certainly does not apply to a considerable number of patients. Thus both the faucial and nasal pseudo-membranes may be treated every second or third hour from the time of their formation with the best disinfectants which we possess, so as to destroy all the micrococci in them and render them an inert mass, and yet croup not infrequently occurs during the progress of the case. Again, in certain cases croup begins at the commencement of the diphtheritic attack. The laryngitis commences as early as the pharyngitis, and therefore does not result from it. Sometimes the inflammation of the air-passages is from the first the predominant

lesion, the pharyngitis being subordinate or even trivial. Thus a boy of two years ten months, whom I attended, died of croup lasting about four days. He lived in the suburbs of the city, where the houses were scattered, and where there had been no recent diphtheria. The attack began with hoarseness, which gradually increased to a fatal obstruction in the air-passages. Close and repeated inspection of the fauces revealed only redness and some swelling of the parts that were visible, and the symptoms indicated but slight coryza. The diphtheritic nature of the disease was rendered certain by the occurrence of diphtheria in its usual form, in the two nurses immediately after the death of the child. In this case croup began at the beginning of the sickness, and it is evident from the history and the lesions that the contagium was not transferred to the larynx from any of the other surfaces. In view of the number of such cases, I see no propriety in assigning to diphtheritic croup a mode of origin different from that of other diphtheritic inflammations. But the possibility, and perhaps probability, in some instances of an auto-infection we will not deny.

Anatomical Characters.—It is important to acquaint ourselves with the anatomical characters of croup, especially with the nature of the pseudo-membrane, that we may know what measures to employ in order to remove it and prevent, as far as possible, the laryngeal stenosis from which so many perish. The surface of the larynx, trachea, and, in severe cases, that of the bronchial tubes, is hyperæmic and swollen, and the inflammatory action involves more or less the submucous connective tissue, causing infiltration or œdema. The relation of the exudation to the mucous surface varies according to the kind of epithelium present. Where the epithelium is of the flat or squamous variety, the fibrinous exudation from the bloodvessels is poured out around the epithelial cells, which perish. If the inflammation extend more deeply, the underlying connective tissue is also embraced in the coagulation and perishes. Prof. Ziegler, of Tübingen, who has made repeated microscopic examinations of the pseudo-membrane, says: "It sometimes happens that the dead epithelial cells become saturated with the exuded liquid and then pass into a peculiar condition of rigidity akin to coagulation. The seat of this change appears to the naked eye as a dull, raised, grayish patch surrounded by red and swollen mucous membrane. The exudation is rich in albumen and the transformed cells take on the appearance of a kind of coarse meshwork, almost or altogether devoid of nuclei." This is superficial diphtheritis, and Prof. Ziegler next describes deep or parenchymatous diphtheritis as follows: "It is characterized by the coagulation, not merely of the epithelium, but also of the underlying connective tissue. The affected patch is swollen and assumes a whitish or grayish tint, the discoloration extending through the epithelium to the connective tissue structures. The epithelium in some cases is lost altogether, and then the diphtheritic patch consists of dead connective tissue only. . . . The dead tissue is separated from the living by a zone of cellular inflammation. Fibrinous filaments are seen here and there through the mass. The lymphatics in the neighborhood contain coagula and leucocytes."

Squamous epithelium covers the nostrils, buccal cavity, fauces, the

larynx upon and above the superior vocal cord, with the exception of its anterior aspect. The pseudo-membrane, therefore, upon all these surfaces lined with this form of epithelium consists of the exudate from the blood which surrounds and permeates the epithelium, or epithelium and subjacent connective tissue. These two distinct elements, that poured out from the bloodvessels and the normal tissue of the mucous surface now dead, incorporated in one mass, therefore, constitute the pseudo-membrane. Its intimate relation with the surrounding living tissue is such that we cannot detach it without lacerating the latter and causing bleeding.

The anterior aspect of the larynx from the middle of the epiglottis downward, all that part of the larynx below the superior vocal cord, the entire trachea, and the bronchial tubes, are lined by columnar epithelium. Whenever this variety of epithelium is present, the exudate from the blood does not become incorporated with the mucous membrane, but escapes to the surface and coagulates in a layer over it. It is, therefore, loosely adherent to the underlying tissues, being attached to it by some fibrinous threads, and when it is peeled off, the hyperæmic and swollen mucous membrane is seen underneath in its entirety, unless, as is commonly the case, a considerable part of its epithelium has been shed and been expectorated. The loose attachment of the pseudo-membrane in the trachea and bronchial tubes is of the greatest significance in its relation to tracheotomy.

In this connection it is proper to call attention to the confusion which occurs in the use of the terms diphtheritic and croupous, as employed by pathologists on the one hand, and clinical observers or practitioners on the other. Pathologists, following Virchow, designate the inflammation diphtheritic when the epithelium and underlying tissues remaining *in situ* are blended with the exudate and become a part of the pseudo-membrane, whatever may be the cause of the inflammation, and they designate the inflammation croupous, whatever its cause, when the exudate escapes to the surface of the mucous membrane, as in the trachea and bronchial tubes, and coagulates upon it. Therefore, in all cases of pseudo-membranous inflammation of the air-passages, even that due to "taking cold," or to inhalation of an irritating vapor, they term the laryngitis diphtheritic, since in the larynx the exudate is incorporated with the mucous membrane, while the pseudo-membranous tracheitis or bronchitis in the same patient is termed croupous, since the exudate lies upon the surface. Practitioners, on the other hand, apply the term diphtheritic to all inflammations which occur as local manifestations of the specific disease, diphtheria, and only to such inflammations, whatever may be their form, whether pseudo-membranous or catarrhal.

The epithelial cells embraced in the pseudo-membrane undergo a histological change. We have stated Ziegler's remark that they are permeated by the exudate of the blood. Cornil and Ranvier say, "Wagner admits the fibrinous degeneration of the cells. . . . We have verified the description given by Wagner, but we would conclude that the cells are filled with a material which approaches mucin rather than fibrin." In the first week, the pseudo-membrane forms more rapidly, and is usually thicker and more extended, producing dyspnœa more

quickly than when it forms in the declining stage of the disease. If the membrane be detached by the forcible coughing of the patient, it is usually quickly reproduced unless the diphtheria be in its advanced stage and abating. If the croup continue from four to six days, the pseudo-membrane begins to soften from commencing decomposition and to disintegrate. The minute fibres which attach it to the membrane give way, and in favorable cases by the effort of coughing or vomiting it is thrown off. Separation is aided by the muco-pus which collects underneath.

Symptoms.—Whenever croup is one of the local manifestations of diphtheria, such general or constitutional symptoms are present as pertain to this blood disease, such as febrile movement, anorexia, thirst, and progressive loss of flesh and strength. The temperature in the commencement in croup from this cause is usually higher than at an advanced period, unless some complication occur, as pneumonia, which increases the heat of the system. The temperature is not, however, in the beginning, ordinarily above 103° or 104°, and, as the croup continues, and the systemic blood-poisoning becomes more marked, the temperature usually falls, so that, even in the gravest cases, it is often at or below 100°. Most patients also have those inflammations which commonly attend diphtheria, *i. e.*, pharyngitis and more or less coryza, but they are relatively unimportant in comparison with the croup, for, unlike the croup, they do not in themselves involve immediate danger to life.

Croup commonly begins gradually and insidiously, revealed at first to the physician by hoarseness or huskiness of the voice, and a hoarse or harsh cough. Both voice and cough are feeble, lacking the fulness and sonorousness present in spasmodic laryngitis. In grave cases approaching a fatal termination, the voice becomes more and more indistinct, and finally is suppressed. The cough, also, which in the beginning of the croup was strong and expulsive, becomes feeble and ineffectual, and less frequent as the fatal result draws near.

The amount of sputum varies considerably in different cases. If the inflammation extend no further downward than the trachea, it is scanty, but if there be coexisting bronchitis, it is more abundant, consisting of muco-pus with occasional flakes of pseudo-membrane. By vomiting a larger quantity is expelled than by the cough. Occasionally masses of pseudo-membrane of considerable size are expectorated, even moulds of some part of the respiratory passage, always with great temporary relief to the patient. A pseudo-membrane of considerable thickness and extent obstructs the expectoration of muco-pus, which collecting in the lower part of the trachea and in the bronchial tubes, greatly increases the dyspnœa. The respiration is somewhat more frequent than in health, but it is not notably increased except when bronchitis or broncho-pneumonia is present. At an advanced stage, when stupor supervenes from non-oxygenation of the blood, the respiration may be slower than in health.

Croup in its commencement and in the active period of diphtheria without treatment almost never remains stationary or abates. Little by little or often quite rapidly, the laryngeal stenosis increases, and soon the patient begins to experience the want of air. He becomes restless,

has an anxious expression of the face, seeks change of position, reaching out his arms to the nurse or mother to obtain relief. In some patients only a few hours elapse and in others a day or more of gradual increase in the obstruction, when it becomes evident that death must soon occur unless relief be afforded. In this stage the post-clavicular, infraclavicular, suprasternal, and inframammary regions are depressed during inspiration, and the larynx is drawn with each inspiratory act toward the sternum. While there is constant suffering, there are also occasionally most distressing attacks of dyspnœa attended by an increase in the lividity of the features and extremities, which now have an habitual dusky pallor. Sometimes these attacks are perhaps due to the doubling of a detached end of the pseudo-membrane on itself, or perhaps to a movement of the muco-pus by which bronchial tubes are occluded. With the ear applied over the larynx or upper part of the sternum, a loud rhonchus is heard both on inspiration and expiration, produced by the passage of the air over the obstruction, and obscuring to a great extent the other sounds. Moist bronchial râles are also common.

Those who recover from membranous croup without tracheotomy, and by the use of inhalations, and thus far they constitute only a small minority, usually improve gradually, the obstruction diminishing by softening and detaching of portions of the pseudo-membrane, the cough becoming looser and the voice less hoarse. After the detachment of the pseudo-membrane, several days elapse before the thickening and infiltration of the mucous membrane disappear and the epithelial cells are restored.

Diagnosis.—Catarrhal laryngitis with an unusual amount of thickening and infiltration of the mucous membrane and the underlying connective tissue, so as to produce stenosis and obstruct respiration, may be mistaken for pseudo-membranous laryngitis. In the New York Foundling Asylum, two children have at different times died with the symptoms of membranous laryngitis, and the obstruction was found to be due entirely to the thickening and infiltration of the mucous and submucous tissues of the larynx by newly formed corpuscular elements. Of course, death from catarrhal laryngitis is rare, but that this disease may produce such an amount of laryngeal stenosis as to cause even fatal dyspnœa, like that from the presence of pseudo-membrane, those two cases show. In most instances, the diagnosis of membranous laryngitis from catarrhal laryngitis is easy, by the presence of patches of pseudo-membrane on the fauces, or by the history of the case, which evidently points to diphtheria as the cause. I have elsewhere alluded to a child in my practice who died with the symptoms of acute laryngeal stenosis, without any pseudo-membrane upon visible parts, and with only a moderate pharyngitis. This case, which might have passed as one of catarrhal laryngitis, accompanied by an unusual amount of cellular and serous infiltration, as there was no known diphtheria in the vicinity, was really due to diphtheria, and was a local manifestation of that disease, for immediately after the death of the patient the two nurses had unequivocal symptoms of diphtheria. The difficulty in using the laryngoscope in young children is such, when their fauces are swollen, that it has not heretofore aided much in the differential diagnosis of the various forms

of acute laryngeal stenosis in young children, at least when employed by the general practitioner.

PROGNOSIS.—The mortality from croup obviously depends to a great extent on the prevalence and the type of diphtheria. From what has been stated above, it follows that croup is more frequent and more fatal in a grave form of diphtheria than in mild epidemics with a less degree of blood-poisoning. In New York City, during the fifteen years ending with 1878, the percentage of recoveries was very small, both under medicinal treatment and tracheotomy. During this long period, surgeons, not saving more than three to five per cent. of their cases by tracheotomy, performed this operation reluctantly. But since 1878 the percentage of recoveries after tracheotomy has been much greater. The mortality from croup is greater the younger the patient; for the younger the child, the less the diameter of the air-passages, and the more quickly laryngeal stenosis results. The younger the child, also, the more difficult is the use of the proper remedies, and the less the time for their use before fatal dyspnœa occurs. We have already said that croup appearing in the declining stage of diphtheria is less severe and more easily controlled or cured than when it occurs in the commencement of diphtheria. Much depends, also, upon whether the physician is summoned at the very beginning of the croup, and appropriate remedies are early and persistently employed. In many instances the friends do not take alarm, and the physician is not summoned till the disease is well under headway, and there is not the requisite time for the action of inhalations. Obviously, also, croup, beyond all other diseases, requires faithful and intelligent nurses, for without the coöperation of such nurses night and day, in the care of the patient, the most judicious measures are often rendered inefficient.

Exact statistics are lacking to show what proportion of cases of croup recover by strictly medicinal treatment. If we regard as incipient croup those cases in which the voice becomes hoarse or harsh, but no dyspnœa occurs, and the lungs are fully and normally inflamed, a considerable number, I think, more than fifty per cent. in my practice, recover. There may be in these cases a catarrhal laryngitis, or there may be a thin film of pseudo-membrane upon the laryngeal surface, not sufficient to embarrass respiration. Slight laryngitis, therefore, occurring in the course of diphtheria, unaccompanied by any increase in temperature, or change in the freedom or rhythm of respiration, and whose only symptom is a huskiness of voice, if treated early and properly by inhalations, passes off in a few days in a large proportion of cases. It possesses little importance except that it might be the initial stage of croup if neglected. It is obviously improper to consider this trivial form of laryngitis as membranous croup, although by neglect it might become such. In the statistics of croup, those cases only should be included in which the symptoms are so pronounced that it is evident that more or less laryngeal stenosis is present, although there may as yet be no marked dyspnœa.

In determining the percentage of recoveries in croup, it is proper to arrange cases in two groups: 1st, cases which have received only medicinal treatment; 2d, cases in which tracheotomy has been performed.

Having been in almost continuous practice since diphtheria began in New York, in a section of the city where this disease has always been prevalent, and having witnessed all kinds of treatment—that by emetics, by depletion, by stimulation, by inhalation and insufflation—it is my opinion that not more than one in eight has recovered by medicinal treatment in this long period, of cases of croup which began in the first week of diphtheria, and in which the symptoms were so pronounced as to indicate more or less laryngeal stenosis. The exudation in the first week of diphtheria, or in its active period, occurs so rapidly, and in such large quantity, that no one of the medicinal agents or modes of treatment, which physicians commonly prescribe, is sufficiently prompt in its action to prevent the formation of the pseudo-membrane to an extent that soon endangers life. I allude to what has hitherto been the result.

Perhaps we may yet discover a mode of treatment that more effectually controls the formation of pseudo-membranes.

Croup occurring in the second or third week of diphtheria, since it is attended by less abundant and less rapid exudation than when it occurs during the acute stage, can be more successfully treated under the persevering use of solvent inhalations, and, according to my observations, a larger proportion than one in eight, perhaps one in three, recovers by the early and continuous or almost continuous use of inhalations.

Still the mortality is so large, and the suffering so great in croup, at whatever stage of diphtheria it occurs, that we cannot rely on the slow action of medicines or inhalations, and surgical treatment is in most instances required to diminish the suffering, and afford the best chances for saving life. Tubing the larynx, to which we will allude hereafter, has been so seldom performed, and the statistics of it are so meagre, that we are unable to state what proportion of patients may be saved by it. I have twice observed in the New York Foundling Asylum prompt relief from tubage, when the dyspnœa was so great as to threaten immediate death. In one of the two patients the relief was temporary, and in the other permanent. If the obstruction were confined to the larynx or larynx and upper part of the trachea, tubage would, I think, come into general use as a substitute for tracheotomy, but, unfortunately, it fails to give relief and save life in those many cases in which the obstruction extends throughout the trachea and into the bronchi. The statistics of tracheotomy, on the other hand, are abundant, and we are enabled therefore to determine to what extent it can rescue the victims of this disease from impending death. *The American Journal of Obstetrics* for May, 1868, gives the results of tracheotomy performed by Drs. Jacobi, Krackowizer, and Voss as follows:

	Cases.	Recoveries.	Deaths.	Per cent. of recoveries.
Jacobi, Krackowizer, and Voss	166	39	127	—
J. H. Ripley, N. Y. Med. Record, 1880	56	16	—	—
Parisian Children's Hosp., 1851–1875 (Tenné)	4663	—	—	24
Bethanien in Berlin, 1861–1872 (Bartels)	330	103	—	31.2
Berliner Chirurg. Klinik, 1870–1876 (Krönlein)	504	147	—	29
St. Annenspital Wien (Monti)	210	—	—	33
Table of Monti from various sources	2608	—	—	25
Hofmohl's statistics	3760	—	—	27

	Cases.	Recoveries.	Deaths.	Per cent. of recoveries.
Küster's statistics	1556	—	—	32
C. Hospital, Trousseau, Paris, during 1883 (per Dr. L. Enfance)	359	115	244	32
Clinic of the Zurich Kantonspitals, under Rose and F. Krönlein, 1868, March, 1882 (11 under 2 years, 1 of 8 months)	238	92	—	39
Deutsche Zeitschrift für Chirurg., 1882, Bd. xvii. (H. Lindner)	101	—	—	37⅔
Statistik der Tracheotomie per Croup, Deutsche Chirurger Lieferung, 37 Stuttgard, 1880, by Kühn	277	125	152	—
Hôpital des Enfants Malad., Paris, 1850–1857	389	86	—	22
Hôpital des Enfants Malad., Paris, 1860–1867	813	208	—	—
Trousseau, according to Kühn	466	126	—	25
Guersant (Sédillot), Med. Opér., ii. page 480	171	36	—	21
Barthef, Hospital St. Eugenie, 1855–1868	573	160	—	28
Cases in the Parisian Hospitals and in the Provinces, Fascher et Bricheteau	1011	—	—	25
Roser (Lissard), C. C., 1854–1861	42	19	—	45.4

	Operations.	Recoveries.	Per cent. of recoveries.
Uhde, Archiv f. Klin. Chir. 1869, 1820–1869	81	21	25
Max Muller (Langenb. Arch. f. Klin. Chir. vii.)	45	15	33
Bardenheuer (Cölner Bürgerhospitals, 1875–1876)	129	46	35.6
Krankenhause Bethanien, 1873, and following (H Settegast)	375	119	31.75
Billroth, Chirurg. Klinik Wien., 1871–1876	18	1	—
Reisz, Bronchotomiens Indicat., 1858	17	5	—
Wansher (Copenhagener Kommuni Hospitals, Sept. 1863, Dec. 1876)	400	170	42.5

The result of tracheotomy in infants is much less favorable than in older children. Dr. Gustav Chagin[1] has published the statistics of cases in infancy. These cases, 977, occurred since 1874; and of this number, 832, or 85 per cent., died. In the Copenhagener Kommuni Hospital, in which, as stated above, there was the remarkably good general result of 170 recoveries in 400 tracheotomies, only 5 per cent. recovered of children under one year; of 76 operated on between the ages of one and two years, 22 recovered, or 29 per cent.; while of 296 operated on between the ages of two and ten years, 146 recovered, or 49.3 per cent. In the Krankenhause Bethanien, the results of tracheotomy from the beginning of 1861 to the close of 1876, tabulated according to the age, were as follows (H. Settegast):

Age.	Tracheotomies.	Recovered.	Per cent.
2 to 3 years	93	22	23.65
3 " 4 "	165	47	28.45
4 " 5 "	175	54	30.85
5 " 6 "	107	39	35.45
6 " 7 "	90	34	37.77
7 " 8 "	59	17	38.86
8 " 9 "	24	11	45.83
9 "10 "	15	6	40.00

The statistics show that the older the patient upon whom tracheotomy is performed, other things being equal, the greater the percentage of

[1] Archiv für Kinderheilkunde, Bd. iv.

recoveries. Prof. Abraham Jacobi has probably performed tracheotomy for croup in as many cases as any other physician or surgeon in this country, not fewer, he thinks, than 400 times. His opinion corresponds with the common belief that, during the last five years, the percentage of recoveries after tracheotomy, in New York City, has been much larger than previously, and the operation is performed more frequently by the attending physician than formerly. The result of tracheotomy during a long series of years, ending with 1878 or 1879, was so unfavorable, on account of the type of the disease, that Dr. Jacobi thinks, in the aggregate of his cases of tracheotomy since 1858, only about 12 per cent. recovered.

Although at present in this city the percentage of recoveries after tracheotomy is much larger than formerly, yet the statistics of some of the prominent physicians and surgeons show nearly as large a proportion of deaths as in former years, probably because the operation has been deferred till the patients were nearly moribund. Thus, one surgeon records only 4 recoveries in 21 operations during the last three or four years, and a physician of large experience, connected with one of the institutions where children are treated, has been equally unsuccessful in his tracheotomies, but he has operated only when the dyspnœa was extreme, and death momentarily expected. Earlier operation might have given better results.

The statistics of recent tracheotomies, which seem to me to indicate most accurately the results of this operation when skilfully performed, and not at too late a stage in the type of diphtheria now prevailing in this city, I have obtained from Drs. J. H. Ripley and Fred. Lange. The operations embraced in their statistics were performed since January 1, 1879, with the following result:

Tracheotomies.	Died.	Recovered.	Per cent. of recoveries.
66	44	22	33⅓

These surgeons do not select cases for the operation, but they operate on nearly every patient with croup, to whom they are summoned, provided that death seems inevitable without tracheotomy. They operate even if serious complications be present, as nephritis or pneumonia, or the blood be profoundly poisoned. With them the inducement to operate is sufficient if tracheotomy diminish the suffering, or increase the chances or recovery in however trifling a degree. Inasmuch, therefore, as they do not select cases, so good a result is noteworthy.

Some physicians in this city make greater discrimination in cases, and do not operate if the condition of the patient be such that death will in all probability occur after tracheotomy. They do not, therefore, advise the operation, if the patient have profound blood-poisoning or severe local disease elsewhere than in the air-passages. Such physicians by the early performance of tracheotomy, and by careful attention to the after-treatment, making frequent visits and supervising the details of the management, furnish more favorable statistics of the operation than those published above. Thus, Dr. A. R. Robinson, who carefully considers the indications and contraindications of tracheotomy, who operates early,

does not insert the canula until all loose muco-pus and shreds of pseudo-membrane are expelled by the cough from the trachea and bronchial tubes, and who supervises by frequent visits the after-management, has saved since 1880 eleven in thirteen consecutive cases of undoubted membranous croup. It is seen from the above statistics that we can claim for tracheotomy judiciously performed, and at a sufficiently early stage, the cure of one in every three patients in the average. The statistics in Boston show that the results obtained in that city in hospital practice have been about the same as those in New York and in European cities. In an interesting paper on tracheotomy in croup, published in the *Medical News*, July 12, 1884, the writer says: "Tracheotomy for this disease has been performed one hundred and eighteen times at the Boston City Hospital during the past twenty years. Thirty-nine, or one in three, were successful. That the cases were not selected is shown by the fact that three patients died during the operation from shock and exhaustion, not from hemorrhage; thirty-four died within twenty-four hours; and fifty-six, or more than one-half of the fatal cases, within forty-eight hours. Four, if not five, of the successful cases were practically moribund at the time of the operation. . . . The ages of these patients ranged from nine months to forty-one years. The youngest to recover was eleven months; the oldest sixteen years. Four aged two years and five aged three years got well. Membrane was visible in the fauces or trachea in a large proportion of both the successful and unsuccessful cases. Its absence was noted in only three of each class. It need not be said that in every instance there was present severe, constant, and increasing dyspnœa, exhausting the strength and threatening suffocation."

Preventive Treatment.—In attending a case of diphtheria the physician should notice at each visit whether the patient have any hoarseness or other signs indicating implication of the larynx, since, if the danger be recognized at its inception, it may perchance be averted. Ineffectual as inhalations may be for fully declared croup, we have seen in speaking of the prognosis that experience fully justifies the belief that they are sufficient in a large proportion of cases to relieve that degree of laryngitis which is indicated by simple hoarseness, and which if it continue might eventuate in serious obstructive disease. If the physician observe such symptoms, he should immediately recommend that the air in the apartment be kept moist by the croup kettle or pans of hot water over the fire, into each of which a lump of lime is placed. I frequently surround the bed with a tent made with a clothes-horse, over which blankets are thrown, and place the croup kettle underneath. Frequently stirring the water in the kettle adds to its efficiency. I prefer, however, in most instances, to employ the steam atomizer either with or without the croup kettle. It should be so constructed that it throws a heavy spray of rather turbid lime-water, and should be almost continuously used as long as the premonitory symptoms of croup continue. It obviates the necessity of heating the apartment, which in hot weather is very uncomfortable.

It is proper, in this connection, to consider which is the most efficient and the best agent for inhalation in croup. Have we an agent that can be safely used, which will prevent, when inhaled, the formation of the

pseudo-membrane, or which will dissolve it when it has already formed? The agents which have been most employed for this purpose are lime-water, lactic acid, pepsin, and bromine.

In selecting the one that is safest and most efficient, the important fact should be borne in mind that anything which irritates, so as to increase the inflammation of the mucous surface, is injurious. Whatever intensifies the inflammation, evidently augments the thickening and infiltration of the mucous membrane, and increases the area as well as thickness of the pseudo-membrane. It is therefore harmful instead of beneficial. In my opinion the teachings of Bretonneau and Trousseau did immense harm in the fact that they brought into use agents far too irritating to the sensitive mucous surface. Since the pressing danger in croup arises from the obstruction produced by the pseudo-membrane, and by the thickening and infiltration of the mucous membrane underneath, that agent is indicated, if it can be found, which loosens and dissolves the pseudo-membrane, and at the same time tends to diminish or at least does not increase the inflammation of the underlying tissues by its irritating action. Alkalies exert a solvent action on fibrin and mucin, and as the pseudo-membrane consists of the exudate from the blood largely fibrinous, and of epithelium and connective tissue which have undergone degeneration into a substance resembling fibrin (Wagner) or perhaps mucin (Cornil and Ranvier), their employment seems to rest on a sound therapeutic basis. Lime-water slightly turbid, but not so turbid as to clog the point of the steam atomizer, and containing about one and a half per cent. of liquor potassæ, is probably as efficient and useful a solvent as any of the alkaline mixtures which have been commonly used. One and a half per cent. liquor potassæ becomes about one per cent. when mixed with steam from the boiler. Dr. E. M. Moore,[1] of Rochester, recommends insufflation of sodium bicarbonate as an active solvent of the pseudo-membrane. It possesses this advantage, that it is but slightly irritating, so that it can be used in substance or with but little dilution. For this reason it should be preferred to lime-water, which is in more common use.

By the persistent and timely use of such inhalations as soon as hoarseness appears, croup can, in my opinion, be often prevented. But we all know how often, notwithstanding our best endeavors, croup occurring in the first week of diphtheria grows hourly worse. In these acute and rapid cases inhalations of the best agents which physicians have hitherto used, act too slowly to prevent the growth of the pseudo-membrane, and in a few hours it becomes painfully evident that something more must be done or the life of the child is lost. In those many cases in which diphtheria is ushered in with croupous symptoms, and in which, within a few hours, laryngeal stenosis begins to occur, the experienced physician sees at a glance, often at his first visit, that inhalations, however faithfully employed, will be inadequate, and that suffocation, the most painful of all modes of death, will be inevitable, unless other and energetic measures are used.

On the other hand, in the milder forms of croup, in which the exuda-

[1] Transactions of the N. Y. Medical Association, 1885.

tion has but moderate thickness and forms slowly, inhalations are of the greatest service, and, aided by internal remedies, they not infrequently arrest the disease and save life. The following was such a case: M. J., a girl of two years and five months, took diphtheria on January 6, 1884. I first saw her on the 9th, when a considerable amount of pseudo-membrane covered the fauces. The temperature was but moderately elevated, and a slight discharge occurred from the nostrils. Under the usual treatment the pharyngitis abated, and she seemed to be convalescing until January 14th, when her respiration began to be noisy and embarrassed. On inspecting the fauces a pseudo-membrane was seen upon the aperture of the glottis, apparently dipping down into it. The steam atomizer was employed almost constantly, throwing a spray of lime-water with about one per cent. of liquor potassæ. Each inspiration was accompanied by marked depression of the post-clavicular, epigastric, and inframammary regions, and the respiration was noisy and embarrassed till the 17th, when it began to improve, and the patient was soon out of danger. It will be observed that the croup commenced in the second week or in the declining stage of diphtheria. Had it been earlier, when the inflammation was more active, and the exudation more rapid, in all probability the patient would have perished unless saved by tracheotomy. The slowness of the exudative process afforded time for the action of solvent inhalations. Nearly at the same time that this case occurred, a patient in my practice, who had recovered from croup by tracheotomy, was seized with dyspnœa a month after the operation, when the opening had healed, and a flapping sound could be distinctly heard, produced probably by a pseudo-membrane, which was partially detached. This obstruction, which for a time apparently involved great danger from the dyspnœa which it caused, was removed by the third day under alkaline inhalations. In such cases, in which the inflammation is mild and the exudation at a standstill, or slow, the benefit from inhalations is most apparent. I am confident that one good result from alkaline inhalations is not fully appreciated by the profession; I refer to the fact that they render the muco-pus, which collects in large quantity in the bronchial tubes, and is expectorated with difficulty, on account of its viscidity, and the obstacle above it, thinner and more easily expelled.

Now that diphtheria has become so prevalent in this country, and so many children perish of the croup which it produces, it is to be hoped that some more efficient, and at the same time unirritating substance may be discovered for inhalation than those at present in use.

Since my attention has been called to the fact, by Dr. Van Syckel, of New York, that trypsine, one of the digestive ferments secreted by the pancreas, is a rapid solvent of fibrin, he having observed its action in the laboratory of Prof. Kühne, of Heidelberg, I have employed this agent in the usual form of diphtheria in several instances with such result as to encourage the hope that the solvent which we have so long needed has been found. I have never seen pseudo-membranes disappear from the fauces more rapidly than in cases in which the following mixture was applied, every half hour, with a large camel's-hair pencil,

whether the good effect was due to the trypsine contained in the extract, or to the alkali, or to the combination of the two:

℞ Extracti pancreatis (Fairchild's) . . . . . ʒj.
Sodii bicarbonat. . . . . ʒiij.—Misce.
Add one teaspoonful of this to six teaspoonfuls of water.

Thus recently, in a child of about five years, a thick pseudo-membrane over each tonsil had disappeared by the third day, without apparently any irritating effect from the application. Mr. Fairchild has recently prepared trypsine in a liquid form, in order that its efficacy can be more readily and conveniently tested as a solvent for the membranes in croup; and Dr. H. D. Chapin informs me that this liquid employed in spray quickly dissolved the pseudo-membrane *in situ* upon the larynx removed from an infant that perished from this disease. Additional clinical observations will soon determine the value of trypsine as a solvent, and whether, if it be a good solvent, it can be utilized as a spray. That it requires an alkaline medium for its activity renders it compatible with alkaline inhalations.

INTERNAL TREATMENT—CALOMEL.—This was long regarded as the most important internal remedy for membranous croup, as well as for diphtheritic exudations elsewhere than in the larynx. In the belief that it had a tendency to prevent the formation of pseudo-membranes, and aided in detaching and removing those already formed, it was in common use until about twenty-five years ago. It was sometimes prescribed for croup in large doses, but more frequently in doses of one-half, one, or one and a half grains, repeated every second or third hour, and often in combination with an opiate, as Dover's powder. However useful a remedy it may be when judiciously employed in croup, as well as in certain other diseases, it fell into disuse on account of its ill-advised employment in diseases which did not require it, its employment often to the extent of producing unpleasant and even dangerous symptoms. When diphtheria was established in this country, calomel was in a few years discarded by most physicians as a remedy for croup, on account of the growing belief that nearly all cases of this disease were local manifestations of diphtheria, and required less depressing and more sustaining measures than mercury. Moreover, it was easy to point out cases in the writings of such masters of the profession as Bretonneau and Trousseau, in which calomel was improperly employed, doing harm by causing not only severe salivation, but also gangrene. Nevertheless cases occurred in those days which seemed to show that this agent properly employed is a potent and useful remedy for croup. One in the Astor House of New York attracted much attention. A child of about two years, stopping at this hotel, had pseudo-membranous laryngitis, with constant and increasing dyspnœa. Prominent physicians summoned to him expressed the opinion that he could not live, when, through the advice of a physician from an inland city, who was temporarily sojourning in the hotel, twenty grains of calomel were placed on his tongue. From this time the dyspnœa began to abate, and the patient recovered.

The medical journals from time to time contain reports of cases of croup in which calomel has apparently been beneficial. Dr. J. P. Klin-

gensmith,[1] of Blairsville, Pennsylvania, states that physicians in his locality prescribe calomel in large doses for croup, and with greater success than that achieved by other modes of treatment, and he relates three cases, showing the result in his own practice:

Case.—A child aged 28 months took twenty grains of calomel placed on the tongue in the commencement of croup, and afterwards ten grains every hour till the third day when 720 grains had been taken. It was now discontinued, and on the sixth day the pseudo-membrane had disappeared. Recovery was rapid, and without any untoward symptoms.

Case.—The second patient, aged three and a half years, had been sick forty-eight hours, with a temperature of 102° F. He had a croupy cough, and a pseudo-membranous exudation. Twenty grains of calomel were administered and afterwards ten grains every hour for fifteen hours, so that one hundred and seventy grains were administered. The child, which had previously been restless, fell into quite a natural sleep. The calomel was discontinued, and a mixture of potassium chlorate and ammonium chloride given in its place. On the fifth day convalescence was fully established, without any unfavorable symptoms.

Case.—The third patient, a girl of four years, had been sick twenty-four hours, with "high temperature, painful croupy cough, labored respiration, dry skin, flushed face, and some diphtheritic" exudation. Twenty grains of calomel were administered and followed by hourly ten grain doses, till twelve doses were given. No other remedy was employed, and in three or four days the patient recovered.

These appear to have been genuine cases, and that they recovered tends to confirm the belief that calomel does exert a beneficial action on pseudo-membranous inflammations, either diminishing the exudation, or promoting the liquefaction and detachment of the pseudo-membrane.

A mode of treatment commonly accepted and practised by the profession through a long series of years usually does some good, in at least a certain proportion of cases, even if it be abused, else it would not have been likely to gain general acceptance. We know how quickly calomel cures the mucous patches of syphilis, even when they are of large size. These are produced by inflammatory changes in the tegumentary system, and they consist largely of epithelial or epidermic cells. They, therefore, contain elements similar to the pseudo-membrane in croup, but without the fibrin. We know also how readily fibrinous opacities on the cornea yield to calomel dusted on them. We may admit that calomel probably exerts a salutary action either on the exudative process or the pseudo-membrane, without being able to state precisely how it acts. Bouchut says of calomel in his article on croup: "This medicine promotes the expectoration and the rejection of the false membrane." Trousseau believed that the beneficial effects of the mercurial preparations were due mainly to their local action. He states that "wherever they can be applied locally" they "modify most powerfully the diphtheritic inflammation." He dusted the inflamed surface, if accessible, with calomel, or with a powder of the red precipitate, one part to twelve of pulverized sugar. The use of the mercurial collar for the neck in

[1] Med. Record, July 12, 1884.

the treatment of croup, employed and recommended by Bretonneau, is familiar to those who have read his memoirs. Professor Jacobi also, who has probably given more attention to diphtheria than any other physician in America, apparently believes that mercury used locally is beneficial in croup, for he has recently recommended inunction with the oleate of mercury upon the neck, whenever the bichloride of mercury administered internally disagrees. It has seemed to me that one or two large doses of calomel administered in the commencement of croup, when there is no decided cachexia, do exert a beneficial action on the course of the disease, as in the following:

CASE.—R., male, aged three years, began to be croupy, but without any marked impairment of the voice, on November 7, 1884. The mother states that he has had sore throat nearly one week, but without medical attendance. He began to be croupy on November 7th, and his respiration gradually became more noisy and difficult till the evening of the 8th, when I was asked to see him.

His temperature was 99°. The dyspnœa was such that the post-clavicular, suprasternal, and inframammary regions were depressed on inspiration, and his breathing was noisy, but the voice had nearly the usual clearness. The fauces, though red, were not notably swollen, and a pseudo-membranous patch of the size of the nail of the little finger lay over the right tonsil. The diagnosis was, therefore made of mild diphtheria, but with dangerous laryngeal stenosis, probably from the presence of a pseudo-membrane; general condition of the child good. Six grains of calomel were placed on the tongue, and inhalation was ordered by the steam atomizer of the following:

℞.—Liquor potassæ . . . . . ʒj.
Aquæ calcis . . . . . Oj.—Misce.

The record of November 10 states: Resp. 38 per minute, still noisy but no increase of dyspnœa; pulse 126; temperature in groin 99⅘°; slight discharge from nostrils; uses the inhalation almost constantly. From this date the pseudo-membrane and redness of the fauces gradually disappeared, and two days later the patient was out of danger.

The results of the treatment of diphtheria and of the inflammations which accompany this disease are liable to produce an erroneous opinion in regard to the value of therapeutic agents, since cases differ so greatly in type or severity. But the experience of many physicians justifies the belief that mercury and especially calomel, employed within certain limits in the commencement of a pseudo-membranous inflammation, does exert some controlling action on this disease. That it did much harm formerly when physicians prescribed it as freely as we now employ potassium chlorate to the extent in many instances of increasing the cachexia, and causing mercurialism, should not deter from its judicious use. In the ordinary form of diphtheria I would not advise the use of calomel, or would limit its employment to one or two doses of six to ten grains in the commencement of the disease in robust cases. But in croup, since the danger is not from the cachexia or blood-poisoning so much as from the laryngeal stenosis which usually develops rapidly, that medicine is indicated, and should be prescribed, which most strongly

retards the exudative process, and aids in liquefying and removing the pseudo-membrane; provided that it produce no deleterious effect which renders its use inadmissible. Hence it is proper to prescribe calomel in larger doses and for a longer time in the treatment of croup, than in other forms of membranous inflammation, if it fulfil the indication as it seems to in a measure. In my own practice, however, calomel is not prescribed after the first or second day, since I prefer the use of other remedial measures, which are efficient, and are less likely to produce injurious effects.

EMETICS.—These have been largely used in all forms of croup, and in catarrhal or spasmodic croup they usually produce marked relief. Formerly emetics were much employed in the treatment of membranous croup, but now that diphtheria has spread throughout the country, and most cases of this form of croup occur in patients suffering from diphtheritic blood-poisoning, depressing emetics as ipecacuanha and antimony have fallen into disuse since they were found to be badly tolerated. In my practice a child of ten years with severe diphtheria and with commencing croupy symptoms, sank rapidly and died between two of my visits, from exhaustion produced by a single large dose of ipecacuanha administered by anxious parents without my advice.

But an emetic gives partial relief to the dyspnœa in certain cases, since it assists in expelling the muco-pus which blocks up the tubes below the pseudo-membranes, and sometimes portions of pseudo-membrane which are easily detached. If an emetic be employed, one should be selected which acts promptly with little depression, and as a rule it should, I think, only be used at the commencement of croup. If after the initial period there be that degree of dyspnœa which suggests its use, tracheotomy is preferable as more likely to give relief, and save the patient. Of the emetics which are admissible in the commencement of croup, sulphate of copper is one of the best. Several years since in one case, in which there were at my first visit dyspnœa, croupy cough, and a pseudo-membrane over each tonsil, and in which I had made an unfavorable prognosis, the parents, observing the good effects of two grains of sulphate of copper, repeated the dose every two to four hours till the following day, and the patient recovered. Such a result however I regard as exceptional. Probably in ordinary cases the best emetic is the yellow sulphate of mercury or turpeth mineral in a powder of two or three grains. The use of this emetic in croup was prominently brought to the notice of the profession by Prof. Fordyce Barker, who administered this agent immediately after being summoned to a case, and he alleges with remarkable benefit to his patients. It has, however, been recently stated on apparently good authority that turpeth mineral when it enters the stomach, although it causes vomiting, is not itself ejected unless in small quantity, so that a considerable share of its action may be through its absorption and like that of calomel.

INTERNAL DISINFECTANTS OR GERMICIDES.—The theory which happens to prevail regarding the nature of a disease necessarily influences the treatment. It is now commonly believed that diphtheria is produced by bacteria, and therefore the use of agents which are destructive to microörganisms is at once suggested as the proper treat-

ment for diphtheria, and for the inflammations which the specific principle of diphtheria gives rise to. Hence sulphite of sodium, sulphocarbolate of sodium, the phenic acid of Déclat, and chlorine preparations have been administered internally in the treatment of diphtheria, but whether they produce a better result than iron and potassium chlorate is doubtful.

But attention is now widely drawn to the bichloride of mercury, which by common consent is more destructive to microörganisms, when employed locally, than any other agent that can be safely used. Physicians in search for a remedy that would destroy micrococci in the system and thus remove the cause of diphtheria were naturally led to make trial of this agent in the hope that an antidote or specific had been found. If the bichloride can be safely administered in doses sufficiently large, there is every reason to suppose that it will destroy the microbe, in the interior of the body as well as upon its surface. If clinical experience show that it can be used in such doses without poisonous effect, it deserves recognition as the specific for diphtheria. If, without injury to the patient, it act promptly enough to kill the microbe before serious organic changes have occurred in the organs, as granulo-fatty degeneration of the muscular fibres of the heart, or nephritis, it would save many lives and become as important a remedy for diphtheria as quinine is for diseases produced by marsh miasm. But unfortunately we have to deal with an agent long recognized as a deadly poison, and it is a problem yet to be solved whether it would not destroy the patient if employed in doses sufficient to destroy the micrococci. A strong argument in favor of this use of the bichloride was presented to the profession by Dr. Thallon,[1] of Brooklyn. His argument was substantially as follows:

It has been shown that the bichloride of mercury destroys the bacteria in a liquid having 20,000 times its weight. Now, if 20,000 grains of blood are disinfected by one grain of the bichloride, 7000 or one pound are disinfected by one-third of a grain. Prof. Flint, Jr., states that, although the proportionate quantity of blood in the system varies in different individuals, it may be assumed that on the average it is in the proportion of one to eight of the entire weight of the body. Therefore one grain of the bichloride would destroy the microbes, and disinfect the blood, in a child weighing twenty-four pounds, two grains in one weighing forty-eight pounds. But if the bichloride can be safely administered to a child in such doses that its system contains one or two grains, still it must be remembered that in diphtheritic systemic poisoning micrococci occur in the lymphatics and the tissues, and therefore a considerably larger quantity of the bichloride is necessary to produce complete disinfection than the quantity which is required to disinfect the blood.

But whether the bichloride administered internally, is a safe, efficient, and proper remedy for diphtheria must be determined by experience. If it be shown to be such by clinical observations, it should of course be administered in all cases, whatever be the seat of the inflammation. It should be administered in the croup of diphtheria, since if we remove the cause, the inflammation will abate or can be more successfully treated.

[1] N. Y. Jour. of Medicine, April, 1884.

A considerable number of observations have been made in the last year showing that adults badly tolerate large doses of the bichloride. Thus one-twentieth of a grain administered hourly to an adult with phthisis till seven or eight doses were given each day produced bloody diarrhœa at the close of the third day, when about one grain had been taken. The same result followed in another adult when one-twentieth of a grain had been administered every second hour in the daytime only, for four days. In a third patient one-twentieth of a grain given hourly in the daytime for five days caused profuse salivation and pain in the gums like that from calomel. A fourth adult patient took one-thirty-second of a grain hourly for eleven hours, and then one-twenty-sixth of a grain for seven hours, when griping pain in the abdomen occurred, and liquid stools. (Dr. A. H. Smith.) One adult case only is related in the experiments of Dr. Smith, in which no ill-effects followed the administration of one-twentieth of a grain doses of the bichloride though administered hourly in the daytime for eight days. Cases might be mentioned in the practice of other physicians, showing that the bichloride is a dangerous remedy if given in germicide doses in the treatment of adults. In one instance in my practice bloody diarrhœa occurred on the fourth day from the uterine douche used three or four times daily, and fatal cases have been announced in the journals from the douche.

But children seem to tolerate the bichloride better than adults, as they do arsenic. It has been largely used during the last year in New York as a remedy for diphtheria, and especially for diphtheritic croup, and physicians of experience state that more patients have recovered from croup under treatment by the bichloride than from any other medication which they had previously employed. (Jacobi.) The following brief statement of the effects of the bichloride treatment in diphtheria and croup in a few cases in the practice of Drs. Thallon, Armor, Skene, Jacobi, and myself will aid to an understanding of the therapeutic value of this agent in pseudo-membranous inflammations.

Case.—A child of 6½ years, having diphtheria after scarlet fever, took gr. $\frac{1}{25}$ hourly, most of the time for one week, and subsequently the same dose hourly in the daytime, and two or three times at night, with no unfavorable symptoms; but the urine was increased to 70 ounces. A child of 4 years, having croup, complicating diphtheria, and with urgent symptoms, took gr. $\frac{1}{40}$ of the bichloride every hour and a half to three hours. In five and a half days she took more than two grains, and in one day more than half a grain. Portions of the pseudo-membrane were expectorated, and the patient recovered. There were no unfavorable symptoms from the bichloride.

Of five children who recovered from the ordinary form of diphtheria reported by different observers, one, aged 9 years, took gr. $\frac{1}{40}$ every one and a half hours, and in one day nearly half a grain, till the fifth day, when a little over two grains had been taken. The second child, also aged 9 years, took nearly one-half grain of the bichloride in the first twenty-four hours, and in two days, three-quarters of a grain. The third patient, aged 4½ years, took gr. $\frac{1}{40}$ of the bichloride every two hours on the first day, and afterwards at longer intervals. In the fourth

case, a child of $7\frac{1}{2}$ years, gr. $\frac{1}{40}$ was given every two hours, for how long is not stated, but the membrane became less on the second day. The fifth patient, aged 2 years 5 months, had a hoarse whispering voice and noisy (guttural) respiration; temperature 105°. The pseudo-membrane appeared over the tonsil in considerable quantity at the close of the second day. The bichloride, gr. $\frac{1}{48}$, was given every second hour alternately with six minims of the tincture of the chloride of iron. Alkaline inhalations were constantly used, and one teaspoonful of brandy given every two hours. The bichloride was administered three days with no appreciable ill-effect, and with gradual improvement of the patient.

Although during the last few months the bichloride has been largely used as a remedy for diphtheria and pseudo-membranous croup, in doses like those employed in the above cases, but few instances have been published in which it seemed to disagree. It has, however, in some patients caused diarrhœa, and apparently colicky pains, as in adults, so that it was deemed advisable to discontinue its further use. According to my observation it does not save life, or materially mitigate the intensity of the disease, or the inflammation, if profound blood-poisoning, or grave complications, as nephritis, have occurred when its employment is commenced.

The following cases, among others which have come under my observation, show that the bichloride if administered in grave cases at a late stage is powerless to save life: A child of $3\frac{1}{2}$ years, with malignant diphtheria, took at first the ordinary remedies, such as iron and potassium chlorate, and when the urine had become heavily albuminous, and the fauces much swollen and covered with a dense and foul pseudo-membrane, the bichloride was prescribed in hourly doses of gr. $\frac{1}{48}$. Two days later death occurred, apparently from the blood-poisoning. Another patient of the same age, and nearly the same history, lived four days under the bichloride treatment. Perhaps better results might have occurred from its earlier use.

Clinical observations will soon determine the actual value of the bichloride in the treatment of diphtheria and diphtheritic inflammations; and if it be a safe and useful remedy, whether its beneficial effects are due to its germicide action, or to the same therapeutic effects as those obtained from other mercurial agents. It may be conveniently prescribed in the following formulæ recommended by Pepper and Thallon:

℞.—Hydrarg. bichlor. . . . . gr. ss.
Tinc. ferri chloridi . . . . f℥iij.
Glycerinæ . . . . . f℥ss.
Aquæ . . . . . q. s. ad f℥iij.—Misce.
One teaspoonful every hour to two hours.

℞.—Hydrarg. bichlor. . . . . gr. ss.
Elix. bismuthi,
Vini pepsini . . . . . āā ℥iss.—Misce.
One teaspoonful every hour to two hours.

It does not seem necessary or prudent in ordinary cases to continue the use of the bichloride more than three or four days in large and frequent doses.

Since membranous croup in localities where diphtheria prevails is in most instances a local manifestation of this disease, the same sustaining general treatment is required which is proper in ordinary cases of diphtheria. The tincture of the chloride of iron, administered every second hour in liberal doses, potassium chlorate, quinine, brandy or other form of alcohol in large and frequent doses, long used in diphtheria as tonics and blood restorers, are indicated. Medicines of this kind may be given between those which are designed to correct the exudative process, and aid in removing the laryngeal obstruction, and which have been described above. The diet should be nutritious and easily digested, consisting largely of milk and the meat teas. For those with poor appetite and feeble digestion, peptonized milk, and the peptonized meat juices may often be advantageously prescribed.

Surgical Treatment.—Although the best possible treatment by inhalations and internal medication be early employed and without intermission, yet it is the common experience in all countries that such treatment is in a large proportion of cases inadequate, and that many perish from suffocation unless relieved by surgical interference. We have stated above, that if croup occur at the commencement of diphtheria when the exudative process is active, and the pseudo-membranes form rapidly and abundantly, death is the common result, if medicinal treatment only be employed. But if the inflammation be less intense or subacute, as in the second week of diphtheria, so that there is more time for the action of medicines and inhalations, and if, as is sometimes the case, the stenosis appear to be at a stand-still, without any marked suffering from want of air, resort to surgical measures may be judiciously postponed.

The indications for surgical interference are a gradual increase of the stenosis and consequent dyspnœa, notwithstanding the constant and judicious use of remedial agents, and a manifest suffering from want of air as shown by restlessness of the child, and the expression of suffering in his features, with or without lividity of the surface. We, adults, may have some faint conception of the suffering, which children with acute laryngeal stenosis undergo, when we have severe nasal catarrh and attempt to breathe with the mouth closed, and the paramount duty of the physician to relieve suffering should prompt to a resort to other measures when medicines prove inadequate, even if we leave out of account the important object of saving life. When therefore membranous croup is found to be progressive after having been observed and properly treated from six to twenty-four hours, and the child begins to suffer from want of air, the propriety of surgical interference should be considered.

Tubage.—In 1858, Bouchut[1] published a paper on a new method of treating croup by tubage of the larynx. He employed a straight cylindrical tube nearly an inch long. The tube was introduced by means of a male catheter open at its two ends. Tubage excited some attention and discussion at the time in the Parisian capital, and M. Gros related a case of its successful employment. It was found in experiments on

[1] Moniteur des Hôpit.

animals that the tube caused ulcerations, and as it did not produce the uniform relief which follows tracheotomy, and was discountenanced by Trousseau, Barthez, and others, it fell into disuse, and was abandoned as a substitute for tracheotomy even by those who at first warmly advocated it. Recently Dr. O. Dwyer, of the New York Foundling Asylum, has devised a tube of about the same length, but differing from that of Bouchut, in having a greater antero-posterior than lateral diameter, and therefore conforming to the shape of the laryngeal aperture. The left index finger, guarded by a broad metallic ring, is carried far back in the mouth of the patient so as to depress the root of the tongue and raise and fix the epiglottis, and the tube is introduced by a curved handle, attached to its inner surface; the handle is detached by a spring. The tube can be readily removed by attaching the handle to the same fastening on its inner surface. Tubing as thus employed usually relieves laryngeal stenosis, and I am not aware that the instrument of Dr. O. Dwyer, although employed in a considerable number of instances, has produced ulceration or other injury of the larynx.

Case.—On May 21, 1884, during my term of service in the New York Foundling Asylum, Florence ———, 3½ years, was admitted at the time of my visit, suffering from extreme dyspnœa. The symptoms of acute laryngeal stenosis were so pronounced, such as great depression at the summit and base of the chest on inspiration, restlessness, and the appearance of anguish in the features from want of air, that the child apparently could not live more than two or three hours without relief. The fauces were somewhat hyperæmic, but without pseudo-membrane. The tube was applied by Dr. O. Dwyer, with immediate relief of the dyspnœa, and the expectoration of a large quantity of muco-pus. Liquid food was readily swallowed when the tube was present, but occasionally some of it entered the air-passages, provoking a cough. Three hours after the insertion of the tube the axillary temperature was 102°. 22d. Breathing still easy; axillary temp. 103°; pulse 130. 23d. The tube has given complete relief; a small pseudo-membrane exists on each side between the uvula and tonsils. 28th. The tube was expectorated to-day, and as the respiration remained normal without the tube, it was not replaced. 30th. Temp. 99⅖°; pulse 136, at times as low as 80; has a loose cough. When the tube was worn and immediately afterwards she expressed her wants in a feeble whisper, which could be understood even when the vocal cords were covered by the tube. The voice gradually returned after the expulsion of the tube, and no further treatment was required. The suffering of the patient was quickly relieved, and her life apparently saved by tubage.

The tube when *in situ* does not produce a cough, or apparently any unpleasant sensation in the larynx. Tubage would in my opinion come into general use as a substitute for tracheotomy, were it not for the fact that the pseudo-membrane in so large a proportion of cases extends beyond the larynx, and the tube fails to relieve tracheal and bronchial obstruction. Since tracheotomy gives equally prompt relief to the dyspnœa, and in a larger number of cases, and enables us to remove the obstruction from the trachea, and to a certain extent from the bronchial tubes through the artificial opening, the almost universal

opinion in both continents that it is preferable to tubage or any other surgical measure, has a valid foundation. Usually it is best not to defer tracheotomy, in order to make the uncertain trial of tubage, when the symptoms are so urgent that surgical measures are required.

TRACHEOTOMY.—Since diphtheria has spread so widely, tracheotomy has become one of the most important operations in surgery. Properly performed, and at the proper time with judicious after-treatment, it rescues many children from a most painful death. The details of this operation are given in surgical treatises, but some general remarks relating to it will not be inappropriate here.

Sanné says that the operator should have three assistants, at least one of them a physician. One should administer chloroform, one use the sponge, and the third, a physician, should be ready to assist in handing instruments, ligating vessels, etc. The operation is simple and devoid of danger, or difficult and dangerous, according to circumstances. The younger the child, the greater the danger, other things being equal. The greatest difficulty and risk attend tracheotomy in fleshy infants with thick and short necks, and in patients who have extreme dyspnœa, and are nearly moribund, so that the operator is impelled to hurry in the operation through fear that death will occur before the trachea is opened. The operator should have time for slow and cautious dissection, that he may avoid wounding vessels and other important parts.

The patient to be operated on should be placed on his back on a table covered by a blanket, and a bottle or block about four inches in diameter should be placed under his neck, so that the head is thrown back at an angle of forty-five degrees, and the anterior surface of the neck rendered prominent. Chloroform is then administered. An incision should be made through the skin in the median line one and a half to two inches in length, according to the age, and extending to within half an inch of the sternum. Through the connective tissue to the trachea the dissection should be slowly and cautiously made with the point of the knife, the scissors, and the blunt hooks which are used to tear the connective tissue and draw aside vessels. The tip of the finger occasionally pressed upon the trachea aids in determining its location, and serves to guide the dissection, which should always be in the median line. Little cutting is required after the skin has been divided, but when fibres of connective tissue resist the blunt hooks, they should be cut either by the point of the knife or the scissors. A grooved director is also useful in the dissection, since by it the operator is enabled to raise and tear resisting fibres, or detach them from parts underneath, so that they can be more readily divided.

Some surgeons prefer the high, others the low operation. In the high operation the trachea is found nearer the surface, and the vessels in the way are less numerous than in the low operation. In the operation, however, the trachea is usually opened at that point, whether high or low, which is most readily reached and laid bare. When this tube is exposed a longitudinal incision is made through its anterior wall sufficiently long to allow the canula to be inserted. It facilitates opening the trachea if it be held by a tenaculum constructed for the purpose with the hook bent so as to be at right angles with the handle. The length

of the incision through the trachea should be about five-eighths of an inch. The canula should not be immediately introduced, but the patient should be made to cough by inserting a pigeon's quill down the trachea into the bronchial tubes. Blood, muco-pus, and shreds of fibrin, if any be present, are expelled through the opening by the cough which the quill produces. The canula is now introduced with or without the aid of the tracheal dilator. The one which is in common use is that devised by Trousseau, with some subsequent improvements. It consists of two concentric cylinders, the external fenestrated, and the disk or plate which supports the tubes is movable upon them.

The result depends to a great extent on the subsequent treatment. The common result is immediate relief to the dyspnœa, but unfortunately in a large proportion of cases the temperature rises about the third day after the operation, and pseudo-membranes begin to form in the bronchial tubes, and in some instances broncho-pneumonia results. Surgeons have endeavored to prevent the formation of membranes in the bronchial tubes after tracheotomy by allowing lime-water to trickle through the aperture into the tubes. Perhaps some other solvent of pseudo-membranes, as bicarbonate of soda or trypsine, might be preferable for this purpose. No surgical operation more imperatively requires intelligent and attentive after-nursing than tracheotomy, since the canula needs to be frequently removed and cleaned whenever obstructed by muco-pus. The febrile movement alluded to above as indicating the extension of the inflammation downwards in the tubes may be in a measure relieved by the application around the chest of one or two thicknesses of muslin wrung out of cool water and covered by oil silk. No certain time can be foretold for the removal of the canula if the patient live. If on withdrawing the inner tube and applying the finger over the end of the remaining canula, the patient breathe easily through fenestra, the laryngeal stenosis has probably so far abated that the tube can be safely removed.

The following is a description of the instruments in the tracheotomy case of one of the most skilful operators in New York City, Dr. Fred. Lange. All of them have small handles like those of dental instruments.

1. *a*. A scalpel, with cutting edge convex, the blade $1\frac{1}{2}$ inches in length, and its greatest width $\frac{1}{2}$ inch. This scalpel is employed in dividing the skin and in the subsequent dissection. *b*. A scalpel of same length, but with narrower blade and straight cutting edge, used for opening the trachea.

2. Two blunt hooks, with the hook straight, $\frac{1}{4}$ inch in length, extending at a right angle from the handle, having a diameter scarcely larger than a carpet needle. The end of the hook is slightly bulbous. A considerable part of the dissection is performed by the blunt hooks which are used in tearing the connective tissue.

3. Three artery clamps, by which bleeding vessels or oozing surfaces are seized, and the instruments with their points attached to the bleeding surfaces are dropped upon the sides of the neck. They thus aid in drawing open the wound.

4. Tenacula. Two with hooks in line with the handle; two others with hooks at right angle to the handle; the diameter of the curves in

the hooks ¼ inch. Those with hooks at right angles are employed for transfixing and holding the trachea when it is to be opened.

5. Two grooved directors, one with the end smaller and more pointed than that of the other.

6. A common artery forceps, also forceps with fine teeth.

7. The spring hook of the oculist, employed by him in separating the eyelids; it holds apart the edges of the wound.

8. The tracheotomy tube consisting of two concentric cylinders, described above.

9. Pigeon's quills; these are important for removing muco-pus and fibrinous shreds from the trachea and bronchial tubes. An instance has come to my knowledge in which the physician who assumed charge of the case after the operation attempted to use for this purpose a small piece of sponge held by forceps; he unfortunately loosened his hold, and the sponge drawn in with the breath produced immediate death by suffocation. This would not have happened with the pigeon's quill.

When the operation is completed and the canula introduced, iodoform should be dusted upon the wound, and two thicknesses of linen soaked with the solution of bichloride of mercury, one part to two thousand, notched so as to surround the canula and pass under its plates, should be applied over the wound, and every hour moistened with the bichloride solution. With such treatment the wound preserves a healthy appearanee and heals readily.

CHAPTER IV.

BRONCHITIS.

Inflammation of the bronchial tubes, or bronchitis, is probably the most frequent disease of early life. It is usually associated with more or less inflammation of the mucous membrane of the nostrils, larynx, and trachea. We designate the disease coryza, laryngitis, or bronchitis, according as one or the other inflammation predominates. Sometimes bronchitis occurs with but slight inflammation elsewhere, and often the coryza and laryngitis abate while the bronchitis is still active.

Bronchitis occurs both as a primary and secondary disease. The secondary form is common in connection with measles, hooping-cough, pneumonia, and pulmonary phthisis, and it is not uncommon in remittent and continued fevers. Bronchitis is acute, subacute, or chronic, and according to its extent it is mild or severe. If the smallest bronchial tubes are involved, the inflammation is designated capillary bronchitis, a term not well chosen, but which is conveniently employed in a description of the malady. Bronchitis is commonly bilateral, affecting the tubes on the two sides with about equal intensity. When

due to tubercles, or to pneumonia, it is often unilateral, being confined to those tubes or nearly to those which are surrounded by tubercular or inflammatory product.

Causes.—The causes of secondary bronchitis are obviously the diseases in connection with which it occurs. The cause of primary bronchitis is the same as that of simple acute laryngitis or coryza, namely, sudden change of temperature from warm to cold, exposure to currents of air, the practice of sending children without sufficient clothing from heated rooms into the open air, the throwing off of bedclothes at night, etc. Dentition is also an occasional cause, since some children have attacks which coincide with the eruption of the teeth. The cough of dentition is usually purely a nervous affection; but in other instances it is accompanied by more or less mucous secretion, and is evidently dependent on a mild catarrh.

Anatomical Characters.—In the most common form of bronchitis the larger bronchial tubes only are affected. They are the seat of the inflammation in most of those cases which are designated "colds" by families, and which are often treated without the aid of the physician. The lining membrane of the bronchial tubes presents the ordinary anatomical characters of mucous inflammations. It is reddened uniformly or in patches intensely, or in that milder degree known as arborescence, according to the severity of the inflammation.

The secretion of the muciparous follicles is at first arrested, and the surface of the membrane is dry. In the course of a day or two the secretory function is reëstablished, and the surface is covered with thin and transparent mucus. A day or two later, the secretion becomes thicker, consisting of mucus and pus. Mixed with these substances are epithelial cells, which are exfoliated in abundance from the inflamed surface. At the same time the mucous membrane becomes thickened and more or less softened. If the inflammation be severe, the vessels of the submucous connective tissue are also injected.

Usually, in about a week in the young child, in from one to two weeks in older children, the inflammation begins to abate. Gradually the inflamed membrane returns to its normal consistence, thickness, and vascularity, and with this return to the healthy state the muco-purulent secretion abates.

In this, which is the simplest and most common form of bronchitis, there is no ulceration, and rarely any pseudo-membranous formation, if the disease be idiopathic. Pseudo-membranous bronchitis is not unusual as an accompaniment of pseudo-membranous laryngo-tracheitis.

Were bronchitis limited to the larger bronchial tubes, it would indeed be a simple affection, but unfortunately it has a tendency to extend downward. Commencing in the larger, it gradually invades the smaller tubes in a similar manner to the extension of erysipelas upon the skin. More rarely the inflammation commences simultaneously in the larger and smaller tubes. Now the gravity of bronchitis is proportionate to the degree of its extension downward. It may stop at any point in its progress, but if it reach the smaller tubes it is one of the most serious affections of early life.

The mucous membrane of the minute tubes, those next to the air-

cells, is delicate, with but little submucous connective tissue, and it frequently, at post-mortem examinations, does not present to the eye those distinct inflammatory changes which are observed in tubes of large diameter. It is sometimes not notably thickened, nor its vascularity much increased, even when there is reason to believe from the symptoms that it was the seat of active phlegmasia. As we pass from these minute tubes to those of larger calibre, the inflammatory lesions become more distinct. The inflammation produces minute and abundant points of redness and the membrane is evidently thickened; often it is rough or granular.

The minute bronchial tubes are very small, especially under the age of three years, and since in capillary bronchitis a large proportion of them are inflamed, the source of the danger is apparent. It is with difficulty that the patient with capillary bronchitis can, by the effort of coughing, free the tubes from the secretions which are constantly collecting in them. In weakly children, under the age of two years, expectoration is most difficult, and hence the great and increasing dyspnœa from which such patients suffer.

In severe and unfavorable cases of bronchitis, which are chiefly those in which the small as well as large tubes are inflamed, the following anatomical changes commonly occur: The muco-purulent secretion, which is tenacious, collects more rapidly in the smaller tubes than it is expectorated by the child, whose strength begins to be exhausted. The accumulation of the secretion is chiefly in the tubes which lie in the posterior and inferior portions of the lung. As the obstruction from the mucopus increases in these tubes, less and less air passes through them into the alveoli with which they communicate, while the quantity of air which passes through the unobstructed tubes into the anterior and superior portions of the lung is proportionately increased. The effect, as regards the state of the lung, is obvious. In cases having a fatal issue, and in which we are therefore able to inspect the lesions, we find that the lower and inferior portions of the organ, from which air was to a greater or less extent excluded, have a diminished crepitation, that they lie a little below the general level, or that certain lobules do, and that they present a congested appearance, for while they contain too little air they have an excess of blood. We shall also find that the upper and anterior parts of the organ, perhaps the entire upper lobe, contain more than the normal quantity of air, so as to rise above the general level. There is distention of the alveoli in these parts, so that they are probably visible to the naked eye, and may appear to be emphysematous, but this is a state distinct from emphysema. It is merely an inflation of the alveoli to nearly their full capacity.

Here and there in the portion of lung in which the inflation has been incomplete, lobules may be observed which are entirely collapsed, having a dusky red color and no crepitation; while in other parts, if the bronchitis have continued some days, there may be nodules of pneumonia. The incised surface of those portions of the lung to which the access of air has been prevented, whether they are collapsed fully, or partially or not, has a reddish color from congestion, and is moist from serum and blood. On compressing the lung, the muco-purulent secretion appears upon the surface in points, having escaped from the divided ends of the

tubes. For other facts relating to atelectasis, the reader is referred to the chapter in which this malady is described.

Exceptionally even when not accompanied by laryngeal croup, fibrinous exudation occurs in the bronchial tubes, forming a delicate film, here and there, and readily detached from the surface underneath, while in rare instances it occurs as a firm and continuous membrane, forming a mould of the tubes, increasing greatly the dyspnœa, and constituting a true bronchial croup. If the patient with severe bronchitis survive, the inflammation of the mucous membrane soon begins to abate. The tubes which have been the seat of the disease, and the alveoli which have been secondarily involved, may return to their normal state almost immediately; but in other instances such anatomical changes occur in them, even when there is no pneumonia, nor atelectasis, that full restoration to their normal state is necessarily somewhat slow. When the function of a lobule ceases, as it does when the tube leading to it is obstructed, not only hyperæmia occurs with or without collapse, as already stated, but its cells and nuclei, and perhaps other parts, begin to undergo fatty degeneration. These elements become granular, somewhat enlarged and opaque, and here and there mixed with them are other large cells filled with oil-globules. These are the compound granular cells of pathologists, and, occurring in this situation, are produced by metamorphoses of the epithelial cells. They are epithelial cells which have progressed more rapidly than others in fatty degeneration, having reached that stage of it which immediately precedes liquefaction. We often with the microscope observe not only these corpuscles, but their fragments as they are dissolving.

Minute abscesses, usually directly under the pleura, have occasionally been observed at the autopsies of those who have recently had general bronchitis, and pathologists are not agreed as to the mode in which they are produced. Some of them, if not all, are evidently connected with the minute bronchial tubes, and the quantity of pus contained in each is not usually more than one or two drops. The most reasonable view of their causation is that they are produced in the terminal tubes where the mucus and pus collect. The pus acts as an irritant and causes inflammation, and the inflammation increases the quantity of pus. The walls of the tube which is now the seat of an abscess are destroyed by ulceration, and probably, also, some of the contiguous air-cells. The little cavity is soon surrounded by a delicate membrane, the same in character, though less thick and firm, as that which constitutes the walls of larger abscesses. The pus presents the usual appearance of this liquid, or it may be tinged by the presence of blood-cells, or again it may be thick from partial absorption of the liquor puris so as to resemble softened tubercle.

The abscess is ordinarily located in the centre of a collapsed lobule. In certain cases it approaches the surface of the lungs, so as to produce circumscribed pleurisy, with adhesion of the costal and visceral pleura. At the autopsy of such a case, on separating the adhesions and attempting insufflation, the air passes through the aperture, so that the lung on that side cannot be inflated unless the aperture be closed. Occa-

sionally pneumothorax results from opening of the abscess into the pleural cavity.

In severe protracted bronchitis dilatation of certain of the bronchial tubes sometimes results. The alveoli in the upper lobes may also be distended beyond their physiological capacity, so as to produce emphysema, but, as we have stated above, their maximum distention within physiological limits must not be mistaken for emphysema. Emphysema in the upper lobes is common in feeble young children, with relaxed and weakened tissues, occurring even without any severe disease of the respiratory organs. It may be vesicular or interstitial. If it be interstitial the sacs of air often attain considerable size, lying as wedges between the alveoli, or like little bladders upon the surface of the lung. It is not difficult to understand how emphysema occurs in severe bronchitis, since the air partly arrested in the tubes leading to the lower lobes enters the upper lobes in increased volume and force.

Symptoms.—It is evident, from the description which has been given of the anatomical characters of bronchitis, that its symptoms vary greatly in severity in different patients. It usually commences with more or less coryza. The symptoms are headache, flushed face, elevation of temperature, acceleration and fulness of pulse. In the mildest cases these symptoms are scarcely appreciable. The child is observed to sneeze and have some defluxion from the nostrils, and this is followed by an occasional mild, almost painless, cough, which declines in the course of a few days. The respiration and pulse are scarcely accelerated, and the appetite is but slightly impaired. There may be a little fretfulness, but the child is not confined to his bed or room, and usually amuses himself with his playthings. Auscultation in these mild cases reveals coarse mucous râles in the larger bronchial tubes, while the smaller tubes are free from mucus. Sibilant and sonorous râles are also observed, especially in the commencement of the bronchitis, at which time the secretion of mucus is suppressed or scanty. The cough in the commencement is for the same reason dry. It becomes looser by the second or third day, the sputum consisting of frothy mucus, with the admixture of pus and epithelial cells. The pus becomes more abundant as the disease continues. Expectoration from the mouth does not usually occur till after the age of four or five years; under this age the sputum is ordinarily swallowed.

The mild form of bronchitis described above, that in which only the larger bronchial tubes are affected, is common to all periods of infancy and childhood, but a severer grade of the disease is also of common occurrence, exclusive of those cases in which the minute branches of the bronchial tree are affected. It has already been stated that there is a tendency in bronchial inflammation to extend downward, and symptoms are proportionate in gravity to the degree of this extension. In severe bronchitis the pulse rises to 120 or 130 per minute, and the respiration is in a corresponding degree accelerated. The cough is frequent and painful, the pain being referred to the sternum, and often there is a steady dull pain in this region. The face is flushed and indicative of suffering, the temperature is considerably elevated, and the appetite is greatly impaired or lost. There is frequently an exacerba-

tion of symptoms in the latter part of the day. Depression of the inframammary region during inspiration, and dilatation of the alæ nasi, accompany grave attacks of the inflammation.

Auscultation in severe bronchitis reveals the presence of râles in all parts of the chest, sibilant and sonorous sparingly, coarse mucous and subcrepitant more abundantly.

General bronchitis or suffocative catarrh, the most dangerous form of this inflammation, is less frequent than bronchitis which is limited to the larger tubes, or to the larger tubes and those of medium size. It may commence quite abruptly, but ordinarily it results from the milder form of the disease. The symptoms at first are such as occur in the common form of bronchial inflammation, but instead of abating or remaining stationary, they gradually increase in severity till, suddenly, marked dyspnœa supervenes. The inflammation has now reached the minute tubes, and what promised to be an ordinary attack of bronchitis becomes one of great severity and danger.

The respiration in severe bronchitis is short and hurried. Sixty to eighty inspirations per minute are not infrequent, while the pulse also is greatly accelerated, attaining as high a number as 140 to 160 or 180 beats per minute. The cough is frequent, and the sputum, which collects in abundance, is expectorated with difficulty. If expectorated so as to be examined, it is found to consist largely of frothy mucus with epithelial cells. After a few days, if the patient live, it becomes more purulent. Sometimes, as in bronchitis of the adult, streaks of blood appear upon the mucus. In the first days of severe acute bronchitis, the temperature is considerably elevated, the face flushed and breathing oppressed. The patient is restless, moving from one part of the bed to another, seeking in vain for relief. The digestive function is impaired, as in all severe inflammations; the tongue is moist and covered with a light fur; the appetite is nearly or quite lost. The infant takes the breast with difficulty, frequently relinquishing it on account of the dyspnœa; older children take no solid food in consequence of the anorexia and the dyspnœa, and even drinks are swallowed hastily and apparently without relish, since deglutition interferes with respiration. On auscultation, in bronchitis of the minute tubes, sibilant, and after a day or two subcrepitant, râles are observed in every part of the chest. Percussion obtains a good resonance, unless the substance of the lung have become involved. As the disease approaches a fatal termination, the pulse becomes greatly accelerated, the respiration is also in a corresponding degree frequent and panting, the inspiration being accompanied by marked inframammary depression and dilatation of the alæ nasi. The face becomes pallid, the prolabia livid, and the tips of the fingers livid and cool. The mucus and pus accumulating in the air-passages, increase more and more the obstruction to the entrance of air, and, finally, death occurs from apnœa. The nursing infant usually ceases to nurse for several hours before death, and a state of stupor commonly precedes the fatal event, due to the accumulation of carbonic acid in the blood. In young infants, especially those under the age of six months, not only in bronchitis of the minute tubes, but in severe ordinary bronchitis, I have often observed, toward the close of life,

intermission in the respiration. It occurs after every six or eight or ten respirations, and equals in duration the time occupied in, perhaps, half a dozen respiratory movements. It is, therefore, an unfavorable prognostic sign, but some in whom it occurs recover by stimulation.

The duration of acute bronchitis varies according to the extent of the inflammation. In the mildest form, the patient is convalescent after three or four days, and, in severer forms that terminate favorably, the disease begins, ordinarily, to decline by the close of the first week or in the second. The progress of bronchitis is somewhat more rapid in young children than in those of a more advanced age. When convalescence is fully established, it is not unusual for the cough to continue three or four weeks, though gradually declining. It is loose and painless, and is scarcely regarded by the patient.

Death sometimes occurs as early as the second or third day in severe general bronchitis. The younger the infant, with the same extent and intensity of inflammation, of course the sooner the fatal result. The ordinary duration of fatal bronchitis is from six or eight days. If the patient pass beyond the tenth day, decline of the inflammation may be confidently expected, and recovery, unless there be a complication.

Occasionally bronchitis becomes chronic, lasting several months before it entirely ceases. The *chronic* form may result from mild, as well as severe, bronchitis. The acute fever and accelerated respiration which characterize the acute affection abate, and the general health is nearly or quite restored; but an occasional cough continues, and the respiration is often audible, from the mucus which collects in the tubes, or from thickening of the mucous membrane. Sometimes there is moderate febrile movement, especially in the latter part of the day. On auscultation, coarse mucous, with perhaps sibilant and sonorous, râles are observed in the chest.

There is great liability in chronic bronchitis to exacerbations. The disease often seems to be abating, and there is prospect of its speedy cure, when all the symptoms are intensified. The exacerbations are due to the fact that the bronchial surface, when it has been a considerable time inflamed, is very sensitive to the impression of cold. Even when the disease is entirely relieved, it is very liable to return by exposure to currents of air or changes of temperature. Chronic bronchitis occurs most frequently in the winter and in the spring and fall, when the weather is changeable, and is most intractable in these periods of the year. Many cases of chronic bronchitis are associated with dilatation of the bronchial tubes or with emphysema. The general health in this form of bronchitis, when not dependent on a tubercular deposit, ordinarily remains good. Tubercular bronchitis, which is the result of a grave disease, does not require separate consideration. It is attended with emaciation, and is obstinate on account of the nature of the primary affection. It is due to the irritating effect of tubercular matter lying against the bronchial tubes.

Diagnosis.—Bronchitis can ordinarily be diagnosticated by the character of the respiration and cough. The absence of hoarseness, stridulous inspiration, and croupy cough, excludes laryngitis; and the absence of the expiratory moan and of the stitch-like pain on coughing, which

characterize pneumonia and pleurisy, excludes those diseases. Accurate diagnosis, however, can be most readily made by percussion and auscultation. Examination of the chest enables us to state with positiveness, not only the nature, but the extent of the affection. If the inflammation be confined to the larger bronchial tubes, coarse râles are discovered in them, while finer mucous râles are absent. If the bronchitis be in the minute tubes, subcrepitant râles are discovered in them. Percussion gives clear resonance on both sides, except in those instances in which collapse or pneumonia has supervened.

Prognosis.—Bronchitis limited to the larger bronchial tubes, or to these and those of medium size, terminates favorably in a large majority of cases. Occasionally, severe inflammation, not extending to the smaller tubes, proves fatal in young infants, or those of feeble constitution. Bronchitis extending to the minute tubes, is, on the other hand, a disease of great danger. It may be fatal at any period of childhood, but the younger and more feeble the patient, the greater the liability to a fatal result. Under the age of one year, it is one of the most fatal diseases of early life.

The prognosis, in the commencement of all cases of bronchitis of average severity in the young child, should be guarded on account of the tendency of the inflammation to extend, as has been already stated in the preceding pages. After five or six days extension ceases, and if during that time no increase in the severity of symptoms occurs, the prognosis is favorable. Signs which indicate an unfavorable result are increasing frequency of pulse and respiration, difficult and scanty expectoration, restlessness, a countenance expressive of suffering, and a progressively greater accumulation of mucus in the bronchial tubes, as determined by auscultation. Pallor and coldness of the face and extremities, lividity of the tips of the fingers, rapid and feeble pulse, drowsiness, diminution of cough, while the mucus and pus accumulate in the bronchial tubes, and, in young children, intermissions in the respiration, indicate the near approach of death. Cases may, however, recover by proper treatment, although the symptoms are most unfavorable.

It is unnecessary to mention the favorable prognostic signs of bronchitis. This disease, when fully established, continues a certain number of days, whatever remedial measures are employed, and, if the symptoms do not increase in severity during the first five or six days, a favorable result is highly probable. The prognosis in chronic bronchitis is ordinarily favorable, so far as life is concerned, provided that no emaciation occur. If there be emaciation, the bronchitis may be due to tubercles in the bronchial glands or lungs, and, of course, the prognosis is unfavorable.

Treatment.—Bronchitis may be rendered much milder, and perhaps prevented by an emetic, employed in the first twelve or twenty-four hours, in conjunction with a warm bath. The physician is not, however, ordinarily called sufficiently early to render this treatment effectual.

Mild Bronchitis.—In mild bronchitis the inflammation is limited to the larger tubes, or to these, and those of medium size. Simple, soothing, expectorant, and laxative remedies are required in the treatment of this form of the disease. Mild counter-irritation may be pro-

duced by camphorated oil or the occasional application of a weak sinapism, and one of the following mixtures may be given. The late Dr. James Jackson, of Boston, in his letters to a young physician, writes of the treatment: "For young children I employ the following: Take of either almond or olive oil, of syrup of squills, of any agreeable syrup, and of mucilage of gum acacia, equal parts, and mix them. Of this mixture a teaspoonful may be given to a child at two years of age; a little less if younger, and increased if older, so as to double the dose to one in the sixth year. This may be given from three to six times in the twenty-four hours. Sometimes a little opiate must be added at night to appease the urgent cough." Another good medicine is the mistura glycyrrhizæ composita, half a teaspoonful of which should be given every two hours to a child of three years, and one teaspoonful to one of six years. The syrupus ipecacuanhæ compositus of the French pharmacopœia, the *contre dé la toux*, consisting of ipecacuanha, senna, thyme, poppy, sulphate of magnesia, orange flower water, wine, water, and sugar, being soothing and slightly laxative, is also an useful remedy. These cases also do well with simple mucilaginous drinks and confinement in a warm room.

Bronchitis affecting the Medium Size or Smallest Tubes.—The use of leeches has been, for the most part, abandoned in the treatment of bronchitis, not only in infancy, but at all ages. The application of dry cups over the sternum is recommended by some judicious physicians as a proper remedy for bronchitis in infancy as well as childhood, and the use of the wet cup is even advocated for robust infants in the commencement of the inflammation; but the beneficial effects of its use can be obtained by other measures which preserve the strength, and are therefore preferable.

Local treatment applied to the chest in bronchitis is important, since, if properly made, it increases the comfort, and obviously diminishes the intensity of the inflammation. Henoch, whose ample experience and sound judgment command attention, if not acceptance of his views, says of local treatment: "I strongly advise hydropathic applications to the chest from the neck to the umbilicus. A napkin or diaper is dipped in water at the temperature of the room, well wrung out, and then placed around the chest, without exercising any compression, so that the arms are free; this is surrounded by a roll of batting, and then covered by a layer of oil silk or gutta-percha paper. When the fever is high these applications should be renewed at least every half hour; later they may be kept for one or even two hours, and this continued for several days and nights. I have occasionally continued it for a week, the cool water being changed to a temperature of 26° to 27° R."

The benefit derived from the cold water application is, according to Henoch, threefold: first, the deep inspiration which the application of cold causes, thus expanding portions of the lungs which are liable to atelectasis; secondly, "derivative irritation of the skin;" and, thirdly, the production of moisture in the air surrounding the child, which he inhales. Deep inspirations are, in my opinion, caused to a greater extent by medicines which excite cough, as ammonia, and warm applications certainly produce more derivation to the surface than cold.

One benefit from the application of cold Henoch does not allude to, and that is the reduction of temperature. But I prefer for this purpose frequent sponging of the upper extremities and face with cold water, and perhaps its constant application to the head. I have observed marked relief from this use of cold water.

For years in my practice the following external treatment has been employed with apparent benefit in nearly every case. For infants under the age of three months, who have accelerated respiration and painful cough indicating the need of external treatment, two poultices of ground flaxseed are prepared, covered by thin muslin, and made so moist that they wet the hand in holding them. They are made as thin as the pasteboard cover of a book, and of such a size, that applied in front and behind they cover the entire chest. Camphorated oil is smeared over their under surface three or four times daily, and over their exterior oil silk is applied. For infants over the age of six months I prefer poultices of the following:

℞.—Pulv. sinapis . . . . . ℥j.
Pulv. seminis lini . . . . . ℥xvj.

The poultice, to give most relief, should be so wet as to cause constant moisture of the surface, and so irritating as to cause constant redness, without necessitating its removal. Vesication should never be produced. Flannel wrung out of warm water made slightly irritating by mustard, and covered by oil silk, also answers the purpose. External treatment should be employed in most instances so long as the respiration is hurried and cough painful. During the stage of convalescence, instead of the poultice, cotton wadding or batting around the chest increases the comfort and prevents taking cold. Derivation to the surface, early made and continued, tends to check the downward extension of bronchitis. Often improvement in the symptoms is observed, especially less dyspnœa and restlessness, immediately on the employment of the local measures recommended above.

Internal Treatment.—Medicines are indicated which have a tendency to diminish the inflammation, to prevent its downward extension to the minute bronchial tubes, and to promote expectoration. The bowels should be kept open in all cases of bronchitis. For robust children, at or over the age of six months, the following prescription is useful in the commencement of the attack:

℞.—Syr. ipecac.,
Spts. æther. nitr. . . . . āā ℥ij.
Ol. ricini . . . . . ℥iij.
Syr. bal. tolut. . . . . ℥j.—Misce.

Dose, half a teaspoonful to one teaspoonful, every second hour, for the age of one to two years.

This prescription is, I think, preferable to the following, recommended by Henoch:

℞.—Hyd. chlor. mitis . . . . 0.01–0.03 grains, $\frac{1}{7}$ to $\frac{3}{7}$.
Pulv. rad. ipecac. . . . . 0.01 " $\frac{1}{7}$.
Sacch. alb. 20.00

To be given every two hours.

But the medicinal agent which experience has shown to be the most useful in the bronchitis of children is one of the salts of ammonium. In the treatment of infantile bronchitis depression must be avoided. The cough should be strong and frequent, for the chief danger occurs from the accumulation of viscid mucus in the minute tubes so as to obstruct the entrance of air into the alveoli, leading to atelectasis, and causing the dyspnœa which is so painful and prominent a symptom in this disease. Ammonium carbonate or muriate, better than any other agent, promotes expectoration by exciting cough, and rendering the mucus less viscid, and it does not reduce the strength. When anxious parents ask me to prescribe something to relieve the cough, I reply that the more frequent the cough the better it is for the infant, since it affords the means of freeing the tubes from the accumulating mucus. Formerly I prescribed largely the carbonate, but Dr. Northrup, Curator of the New York Foundling Asylum, has found evidences of gastritis in the stomachs of infants who have perished from various diseases, for which the carbonate was administered. Since informed of this I have prescribed the muriate. The ammonium muriate may, in most instances, be given with benefit from the commencement, in both mild and severe bronchitis in infants under the age of one year. The following is a convenient formula for its employment:

℞.—Ammon. muriat. . . . . ʒj.
Syr. bal. tolut. . . . . ʒij.—Misce.

The ammonium carbonate should be prescribed dissolved in water, and given to the patient in milk.

Fifteen drops contain one grain, the dose at the age of three months. Five drops should be given at the age of one month, and thirty at the age of six months, in a little water. This expectorant should be given frequently, as every half hour or every hour in cases of severity. The urgent symptoms are relieved by free expectoration, which this medicine more than all others which I have employed tends to produce. It should be given night and day, at the short intervals mentioned, until amelioration of symptoms occurs. The benefit from its use is most apparent under the age of eighteen months, or at the age when capillary bronchitis and atelectasis are most liable to occur.

Medicines which exert a greater controlling effect on the action of the heart than those which we have mentioned, are often required during the progress of severe "bronchitis." If the patient give evidence of declining strength while the pulse is unusually rapid and the temperature elevated, quinine given in moderate doses, as two grains every fourth hour to a child of two years, has seemed to me useful as a heart tonic. The tincture of digitalis in doses of one to two drops every second hour for infants between the ages of six months and two years, is also useful as a heart tonic. In a case recently under treatment by Dr. Jacobi and myself, the infant, aged twenty-three months, having a temperature varying from 102½° to 105½°, respiration 82 to 105, and pulse 165 and higher, took four drops of tincture of digitalis, besides the quinine and ammonium muriate, three days, with apparently a good result from the

digitalis. This remedy was afterwards continued in two-drop doses, and the patient recovered.

For robust children over the age of two years, in the commencement of acute bronchitis, having a full and strong pulse and flushed cheeks, a cardiac sedative is required. The following will be found a useful recipe for such a patient at the age of five years:

℞.—Tinct. rad. aconit. . . . . gtt. xvj.
Syr. scillæ composit. . . . . ʒij.
Syr. bal. tolut. . . . . ʒxiv.—Misce.
Dose, one teaspoonful from two to four hours.

The medicine should be omitted or given at longer intervals, if the frequency of the pulse be reduced. Veratrum viride, on account of its very depressing action is not so safe a remedy as aconite. In children of this age the muriate of ammonium is also required as an expectorant; it may be given between the doses of the above mixture, and when the latter is discontinued it should be given as the main remedy.

When and how to employ opiates, to procure the needed rest in the bronchitis of children, should be carefully considered. We have stated, that a frequent and strong cough is required in the infant in order to prevent clogging of the minute tubes with muco-pus, and to prevent atelectasis. Still, some respite from the cough if it be frequent, is required to prevent exhaustion. I prefer for young infants to give the opiate separately from the expectorant, and only occasionally, as they may need sleep. The following is a useful formula for an infant of six months who is restless and without the proper amount of sleep:

℞.—Liq. opii composit. (Squibb) . . . . gtt. x.
Potas. bromidi . . . . . ʒj.
Syr. rubi idæi (raspberry) . . . . ʒj.
Aquæ . . . . . ʒiss.—Misce.
Dose, one teaspoonful when needed.

Eight drops of paregoric may be given in place of the above. Twice the dose of either of these opiates is sufficient at the age of twelve months. For older children, Dover's powder—an eligible form of which is Squibb's liquid Dover's powder, the tinctura ipecacuanhæ composita—is a useful remedy to procure sleep, one minim of which corresponds to one grain of the powder.

During convalescence medicines should be administered less and less frequently, or in smaller doses. Emetics in ordinary cases of bronchitis are not required, except in the commencement. In severe bronchitis, however, especially when the smaller tubes are inflamed, they sometimes appear to be useful. The cases which may need their administration are those in which mucus and pus collect in the tubes more rapidly than they are expectorated, so as to give rise to urgent dyspnœa. An emetic administered under such circumstances may give prompt and decided relief. The object to be gained is obviously very different from that in the commencement of bronchitis, and such agents should be employed as act promptly with little depression. Ipecacuanha is probably the best emetic for this purpose.

Infants oppressed by the accumulation of mucus and pus may sometimes be relieved by tickling the fauces with the finger. This provokes

vomiting, and the viscid mucus which collects at the entrance of the glottis is removed by the finger.

The diet should, as a rule, be nutritious through the entire disease; but robust patients, or those who have ordinary health, if over the age of two years, and affected with primary bronchitis, are sufficiently nourished by light diet, chiefly farinaceous, in the first days of the attack, after which animal broths are proper. Whatever food is given in severe bronchitis must be in the form of drinks, since the appetite is lost, while the thirst is such that liquids are less likely to be refused.

In primary bronchitis, if mild or of ordinary severity, alcoholic stimulants are not required. In secondary bronchitis they are often needed, and also in severe primary bronchitis, if there be dyspnœa with evidences of prostration. In the infant two drops of brandy for each month in the age, given every second hour, enable the child to expectorate with more freedom and less exhaustion.

CHAPTER V.

ATELECTASIS.

In certain newborn infants the lungs do not undergo inflation, or only a portion of the lobules is inflated, to wit, those in the upper lobes, while the remainder of the organ continues unchanged from the fœtal state. This non-inflation of the lung is designated congenital atelectasis. It is apparently not due, unless in rare instances, to defective formation of the respiratory apparatus, for at the autopsies of cases which have ended fatally, as most cases do, at an early period, insufflation is easy, there being no occlusion of the air-passages, nor unusual adhesion of the walls of the alveoli to prevent the admission of air. Physicians have believed that in some instances they discovered the cause in an enlarged thymus gland, which compressed the lower part of the trachea, but this cause has not seemed to exist, or was exceptional, in cases which I have observed, for although the thymus at birth is large, having nearly the size of an unexpanded lung, it has not seemed to me to be unduly enlarged in most atelectatic cases which I have examined after death.

The ordinary proximate cause of atelectasis neonatorum is feebleness of inspiration, whether due to general debility, as in infants born permaturely, or weakened by placental hemorrhage in the last months of fœtal life, or, as is frequently the case, to injury of the brain and consequent impairment of the function of the pneumogastrics during birth. I have more fully treated of this form of atelectasis in the chapters which relate to the maladies incidental to the birth of the child, and to these the reader is referred.

Acquired Atelectasis, or collapse of lung, is less extensive than congenital atelectasis, being confined to a portion of a lobe, and often to only a few lobules. It occurs chiefly during the period of infancy and in feeble children. It is a common malady, in foundling asylums, in wasted infants who perish before the close of the first year. I have frequently at the autopsies of such infants observed it along the thin inferior margins of the lower lobes, and in the tongue-like prolongation of the left upper lobe. In this class of cases, catarrh of the bronchial tubes appears to have little or no agency in causing the collapse. The cause is found in the impaired functional activity of the lungs. In the state of debility the heart beats feebly and the stream of blood from it to the lungs is small and slow, so that the inspiration of a small amount of air suffices for its decarbonization. The inspirations also are seen to be feeble, causing little expansion of the walls of the thorax. Consequently the entire lung is imperfectly inflated, as is seen in fatal cases, but the distant thin portions of the organ are least expanded. These receiving little or no air, soon begin to contract from the presence of the elastic tissue, and collapse or atelectasis ensues.

This has been the most common form of atelectasis in cases of this malady, which I have observed in foundling asylums, and it probably occurred in the manner which I have described.

Another cause of acquired atelectasis to which all writers allude is bronchial catarrh, which commencing in the larger tubes extends downward into those of smallest size. By the swelling of the mucous membrane, and the accumulation of viscid muco-pus which cannot be expectorated, certain of these tubules become occluded, so that the inspired air is shut off from the alveoli situated beyond them. Occlusions are obviously most likely to occur in the bronchitis of feeble infants, whose cough has little expulsive force, so that debility is also a factor in the production of this form of atelectasis. The portion of lung withdrawn from the respiratory function soon collapses, the air which it contained being probably in part expired, but chiefly absorbed.

Atelectasis is not, however, so important or frequent a complication of bronchitis as was formerly supposed, for catarrhal pneumonitis due to extension of the inflammation from the bronchioles into the lung has been mistaken for it. Solid non-crepitant nodules or portions of lung are frequently observed at the autopsies of infants who have perished of severe bronchitis, and these may be atelectatic or pneumonic, but they are more frequently the latter than was formerly supposed.

The possibility of insufflating these solid portions when removed from the body after death, was till within a few years regarded as decisive proof of atelectasis. It is now known that this is not a reliable test, since a lung solidified by recent catarrhal pneumonitis can be almost as readily inflated as one which is collapsed; but the inflated pneumonic lung is more solid and resisting when pressed between the thumb and fingers than is the collapsed lung. The decisive proof is afforded by the microscope, by which cell-proliferation is discovered within the alveoli in catarrhal pneumonitis, while it is lacking in simple collapse. An increase of the dyspnœa not infrequently occurs in severe infantile bronchitis, without either pneumonia or collapse from the accumulation

in the bronchioles of the secretion which is with difficulty expectorated, but if dulness on percussion and other physical signs indicate solidification of the lung at some point, of course pneumonia or collapse has occurred. If a sufficient amount of lung be involved to produce well-marked physical signs the disease is in most instances pneumonia and not collapse, though it may be the latter. Both these pathological states may, however, occur in the same lung as complications of severe bronchitis. The severe paroxysmal cough of pertussis, especially when accompanied by considerable secretion, frequently produces collapse of portions of the lower lobes, while it causes emphysema in the upper lobes.

Symptoms.—Atelectasis resulting from bronchitis gives rise to no new symptoms. So far as it has any appreciable effect it aggravates certain symptoms of the primary disease, but as it is ordinarily limited to a small area this effect is not very marked. When a bronchial tube is so occluded by muco-pus that the alveoli with which it communicates collapse, there is ordinarily, at the same time, more or less accumulation of this secretion in other tubes throughout the lungs. Therefore, the entrance of air into the alveoli with which these tubes communicate is slow and difficult, but usually without complete obstruction, and without true atelectasis, but with a semi-collapse such as we observe in fatal croup. This explains the dyspnœa which is present in these cases. If the secretion be expectorated from these tubes the dyspnœa abates, even if the plug which has completely occluded a tube and the consequent atelectasis remain.

Atelectasis occurring in wasted and feeble infants, in consequence of the diminished force of the inspirations, does not in most instances give rise to any prominent symptom, since it occurs chiefly in distant thin portions of the lungs. I have observed an occasional short, nearly painless cough in such infants, when the autopsy revealed no pulmonary lesion except the atelectasis.

Anatomical Characters.—The portion of lung which is affected with recent atelectasis has a dark brown or dark bluish color. It is depressed below the general level of the lung, is firm and non-crepitant on pressure and its incised surface is smooth. Hyperæmia supervenes, for a portion of lung in which the circulation continues, but from which air is excluded, becomes congested. In acquired atelectasis the congestion is especially marked, since the vessels which have been adapted by growth for a larger area are compressed into one of smaller extent, so that they become tortuous and bulging within the lumina of the alveoli, while the free flow of blood through them is retarded by the constriction of the elastic fibres of the lung. An obvious and certain result of the hyperæmia is the transudation of serum into the alveoli, producing œdema. This union of pulmonary hyperæmia with œdema by which air is excluded from the alveoli constitutes the state known to pathologists as splenization, and in proportion as it occurs the lung depressed by the atelectasis rises toward the general level. It may even rise above it, and it now has a doughy elastic feel. The pathology of these œdematous atelectatic spots, heretofore obscure, has been clearly explained by Rindfleisch.

If the patient live, and the atelectatic lobules do not soon return to a state of health, they undergo further changes. Rindfleisch says: "From the series" (of changes, provided inflammation do not occur) "we especially render prominent two conditions, *inveterate œdema* and *slaty induration*. But inflammation does commonly occur after a time in a collapsed lung." Those who are familiar with the post-mortem examinations of infants will fully agree with Rindfleisch when he says: "Splenization, quite generally taken, appears to present extraordinarily favorable preliminary conditions for the occurrence of inflammatory changes. It may directly represent the initial hyperæmia of acute inflammation, and be followed by lobular and lobar, but constantly catarrhal infiltrates." It is well known by pathologists that protracted congestion, active or passive, of whatever organ or tissue, is very liable to pass from a state of simple stasis of blood to one of cell-proliferation, and the atelectatic lung, as I have myself observed at autopsies, affords a common example of this. I have several times made or have procured microscopic examinations of the atelectatic portions of lungs of infants who had died, for the most part, in a wasted and enfeebled state, and have found in them clear evidence of the presence of a catarrhal pneumonia. The interesting fact therefore must be recognized, that atelectasis frequently passes to a state of inflammation, so as to present the characters of ordinary hypostatic pneumonia, and no doubt undergo the same subsequent changes.

Atelectasis, when recent and simple or uncomplicated, may soon disappear by the expectoration of the obstructing secretion, if such be present, or if there be no obstruction, by increased force of inspiration. If it do not soon disappear it undergoes one of the ulterior changes alluded to above, and henceforth the symptoms and history are those of the new malady which has supervened.

Treatment.—The treatment of acquired atelectasis is simple. If it be recent and there be evidence that it is due to the accumulation of the secretion in the bronchial tubes, an emetic, which acts promptly and with the least possible depression, may be very useful. It is especially indicated if there be little or no pneumonia, the strength not greatly reduced, and there be dyspnœa with insufficient decarbonization of blood in consequence of the abundance of the secretion in the smaller tubes. An emetic which acts promptly and with little prostration may aid greatly in establishing the respiratory function in collapsed lobules, by expelling the obstruction, and producing a freer and deeper inspiration. One of the best if not the best emetic for this purpose is sulphate of copper, given in a dose of one or two grains to a child of one year. With or without the use of the emetic our main reliance must be on sustaining and stimulating measures, by which the cough, the cry, and the inspirations acquire more volume and force. Most cases require alcoholic stimulants and the ammonium carbonate. Rubefacient applications to the chest are also commonly employed, and are probably useful.

CHAPTER VI.

PNEUMONITIS.

In children over the age of three years, pneumonitis differs but little in form or phenomena from that of the adult, being ordinarily primary except as it depends on an irritant, as tubercles, and extending rapidly over one or more entire lobes. It is the form of pneumonia which is designated lobar or croupous. In those under the age of three years pneumonia is, on the other hand, as a rule, secondary to bronchitis. It is produced by extension of the inflammation from the bronchial tubes into the alveoli, and it affects certain lobules instead of an entire lobe. It is designated catarrhal or lobular pneumonitis. In catarrhal and croupous pneumonitis, the solidification of the lung and exclusion of air are due mainly to the newly formed cellular elements with which the alveoli are filled, though these cells differ in the two diseases. *Interstitial* pneumonitis consists in an inflammation and hyperplasia of the connective tissue of the lungs. It is the chronic pneumonia of authors, resembling in many respects, in its anatomical and clinical characters, cirrhosis of the liver. The inflammation which produces this result is subacute, and in nearly all cases is dependent on some persistent local disease in the minute bronchial tubes or lungs, as softened or cheesy tubercles, cancer, abscesses, protracted inflammation of the alveoli or bronchioles, whether produced by the inhalation of dust of an irritating nature or other cause. Interstitial pneumonia is much more rare in children than adults, and, as it presents no peculiar features in them, it need only be alluded to in this connection.

Causes.—*Croupous* pneumonitis in most cases results from that common cause of inflammations—namely, taking cold. It commences as a primary disease within a few hours after exposure. *Catarrhal* pneumonitis, on the other hand, commonly results from antecedent pathological states, which we will enumerate.

First. Most cases of capillary bronchitis, as we have stated above, result from bronchitis. The inflammation extending downward engages the minute bronchial tubes, and from them traverses the alveoli of one or more lobules. This is the broncho-pneumonia of children described by authors; it occurs most frequently between the ages of six and eighteen months.

Secondly. Hypostasis, or passive congestion, is an important factor in the causation of many cases, and in feeble infants it is not infrequently the sole cause. Infants with feeble health and languid circulation, lying in their cribs day after day with little movement of the body, are very liable to passive congestion of the depending portions of their lungs, and this by and by eventuates in a cell-proliferation within the alveoli—in other words, a pneumonia presenting some peculiarities,

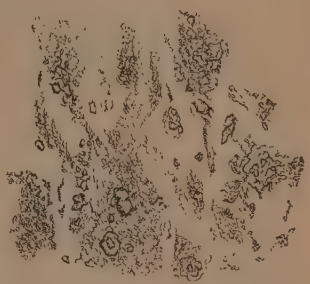
but of the catarrhal form. In foundling hospitals, where feeble infants are received and treated, this is one of the most frequent pathological states, and is the prevailing form of pulmonary inflammation. It is sometimes described as hypostatic pneumonia. Hence physicians whose observations have been largely in such institutions, have almost ignored any other form of pneumonia in infants. Billard, a close and accurate observer, wrote nearly half a century ago: "Pneumonia of infancy presents peculiar characters, in which it differs from the same affection in adults. Instead of being an idiopathic affection arising from irritation developed in the pulmonary tissue under the influence of atmospheric causes, which often excite the disease, the pneumonia of young infants is evidently the result of a stagnation of blood in their lungs. Under these circumstances this blood may be regarded as a kind of foreign body. . . . . It would, therefore, appear that inflammation of the lungs, which produces hepatization, arises in infants, in general, from some mechanical or physical cause." Valleix also states that he found the lesions of pneumonia in a majority of the infants who died in the Hôpital des Enfants Trouvés. The statements of Valleix are applicable also to the Infants' Hospital, the Foundling Asylum, and Nursery and Child's Hospital, of this city, as regards those cases in which death results from chronic disease. We shall see hereafter that hypostatic pneumonia is one of the most common complications of chronic infantile entero-colitis, the summer complaint of the cities.

Thirdly. Catarrhal pneumonia of infants sometimes results from collapse. It is not unusual to find, at the autopsies of infants who have died in a state of emaciation and feebleness, portions of the lungs remote from the bronchi collapsed, as, for example, the thin edges of the inferior lobes, and the tongue-like process of the upper lobe, the process which lies over the heart. The immediate cause of the collapse has been a bronchitis, or it has resulted directly from the general weakness of the infant, and its feeble respirations. Now, a collapsed lung soon becomes the seat of passive congestion. The functional activity of an organ favors circulation through it, and if the function be abolished the flow of blood in the part is retarded, and stasis more or less complete results. The hyperæmic state of collapsed pulmonary lobules presents the same anatomical condition, for the supervention of pneumonia, as occurs in cases of hypostatic congestion. Consequently, cell-proliferation soon begins in the collapsed alveoli, the volume of the affected lung increases, and it becomes firmer and more resisting to the touch, and the microscope reveals the characters of a subacute but genuine catarrhal pneumonitis. I have made or have procured microscopic examinations of a considerable number of such specimens, and have found the alveoli more or less filled with cells of the epithelial character. (See article Atelectasis.)

In rare instances in infancy and childhood pneumonitis results, as it more frequently does in the adult, from an embolus detached from a clot, which had formed in some remote vein, in consequence of arrest of circulation in it, by inflammation of the contiguous tissues. This is described by writers as a distinct form of pneumonitis, designated embolic or embolismal. A specimen showing this mode of causation

was exhibited by me at the New York Pathological Society, in February, 1868. An infant, born January 22, 1868, of strumous parents, had been fretful, but without appreciable ailment till February 3d, when inflammation of the connective tissue occurred on the anterior aspect of the left leg, a little below the knee. This extended downward, suppurated, and the pus was evacuated February 5th. In the mean time three other similar inflammations occurred, two on the right foot and leg, and the other over the parietes of the chest in the right inframammary region. Suppuration occurred in all of these.

FIG. 34.



On February 8th this infant was suddenly seized with extreme dyspnœa, and died in a few hours. Numerous minute puriform collections (formerly called metastatic abscesses) were discovered in each lung, most of them scarcely larger than a pin's head. One of them on the right side in the middle lobe connecting with a bronchial tube had ruptured into the pleural cavity, causing pneumothorax, collapse, and incipient pleuritis.

The annexed figure exhibits the microscopic appearance of this softened fibrin, which, to the naked eye, so closely resembled pus.

On account of the speedy death, the emboli had produced in the lobules where they had lodged little more than congestion or the first stage of pneumonitis around them. Had the infant lived longer, doubtless the ferments or the vibriones, which some consider the irritating element of emboli, would have caused a greater amount and more advanced stage of pneumonia.

ANATOMICAL CHARACTERS.—Nothing need be added in this connection to what has already been said, in reference to interstitial and embolismal pneumonias. Being comparatively rare in children, they present the same anatomical characters as in the adult. That unimportant form of pneumonia called pleurogenous, and which consists in a croupous inflammation of the superficial infundibula of the lung underneath an inflamed pleura, occurs in children as well as adults. Being secondary to the pleuritis, and produced by extension of the inflammation of the pleura, it gives rise to no appreciable symptoms, on account of its slight extent, and as it presents no peculiar features in the child it need only be alluded to.

Croupous pneumonitis, which we have stated is the ordinary form of pulmonary inflammation in children over the age of five years, has the same anatomical characters as in the adult. It ordinarily involves an entire lobe. It is more frequent in the right than left lung, and in whichever lung it occurs its most frequent seat is the lower lobe. The inflammation may, however, be limited to an upper lobe, especially on the right side. It ordinarily commences near the root of the lung, and extends forward.

Croupous pneumonitis presents three stages, that of congestion, red hepatization, and gray hepatization. In the stage of congestion the

capillaries in the walls of the alveoli are greatly distended, bulging forward in loops within the alveolar spaces so as to diminish them, and a viscid albuminous fluid begins to exude, in which points of extravasated blood appear. The affected lung in this stage has a deep red color, its elasticity is greatly diminished, and its density and weight increased. On account of the reduced size of the alveoli from the bulging of the alveolar walls, and the viscid fluid within the alveoli and terminal bronchial tubes, the function of the affected lobe is nearly lost, and hence the dyspnœa which patients experience in the first stage of the inflammation.

The second stage is characterized by the continued and increased escape of the liquor sanguinis and red and white corpuscles through the stigmata or little apertures which exist normally in the walls of the capillaries. The inflamed alveoli and the minute bronchial tubes which terminate in them are filled with this pneumonic exudation. The relative proportion of the elements of the blood in the exudate varies in different cases. Fibrin is always present, immediately coagulating in delicate filaments within the interstices of which the corpuscles are lodged. The white corpuscles in some cases are much in excess of the red, while in others the red predominate. The lung in the second stage contains no air, has a greater specific gravity than water, is friable so as to be readily torn and penetrated by the finger. The torn surface in the adult presents a granular appearance, each granule being the contents of an air-cell. In the child the granules are not distinct on account of the small size of the air-cells, but the volume of the inflamed lobe is somewhat increased as in the adult.

The stage of gray hepatization succeeds, in which the volume of the lung is still greater. The change of color is due partly to compression of the capillaries by the inflammatory material, partly to destruction of the red corpuscles, and disappearance to a greater or less extent of their coloring matter, while the white corpuscles (pus-cells) remain, but it is due more to commencing fatty degeneration in the exudate prior to its liquefaction. In favorable cases the lung soon returns to its normal state, the liquefied substance which filled the alveoli being in part absorbed, in part expectorated.

Croupous pneumonitis often causes inflammation of the portion of the pleura which covers it. Pleuritis developed in this way is circumscribed, but it frequently extends beyond the inflamed parenchyma to the distance of one or two inches. Bronchitis is also a common accompaniment. It may be general, in which case it occurs independently, or be limited to the tubes lying within the inflamed lung, in which case it results like the pleuritis from the pneumonitis. It is seen from this description that the pus-cells which are produced so abundantly in the alveoli are believed to be chiefly exuded white corpuscles of the blood. Possibly some of them may be produced by proliferation of the epithelial cells which line the alveoli, in the same manner as they are believed to be produced in the bronchial tubes.

Catarrhal pneumonitis, which is, as we have stated, for the most part the lobular pneumonitis of writers, and which, with an occasional exception, is the form of inflammation in children under the age of

three years, presents not only clinical but anatomical features, which distinguish it from the croupous form of the disease. Those who have witnessed few post-mortem examinations of young children, and whose views of the lesion are influenced by the expression lobular, suppose that there is an alternation of inflamed and healthy lobules, so that the surface of the lung presents an appearance not unlike mosaic work. This is a mistake. Although an entire lobe is seldom inflamed, as in croupous pneumonitis, the inflammation commonly extends over more or fewer contiguous lobules, but we find certain lobules in the midst of the inflamed area which are but slightly affected or have escaped entirely. The extent of the inflammation is ordinarily from one to three inches, but I have seen a nodule of true catarrhal pneumonia not larger than a pea, while every other portion of the lung was healthy. On the other hand, almost an entire lobe may appear hepatized to the naked eye as in the croupous inflammation, but by a careful examination certain lobules will be found unaffected. Thus, in a case in the Nursery and Child's Hospital, in which death occurred at the age of one year from pneumonitis supervening upon pertussis, an entire lobe, with the exception of a little of its anterior border, presented the appearance and feel of red hepatization, but a careful microscopical examination revealed not only the absence of fibrin in the exudate, showing the catarrhal nature of the inflammation, but also certain lobules in the midst of the inflamed lung, which were not involved. Prof. Delafield, who has made careful microscopic examinations of inflamed lobules in catarrhal pneumonia resulting from extension of the inflammation from the bronchial tubes, says: "In some cases the air-vesicles are filled principally with pus; in other cases almost entirely with epithelial cells; in other cases with both pus and epithelium; in others with pus, epithelium, and fibrin."

Inflammation of the pleura over the inflamed lung is less frequent in this disease than in croupous pneumonia. The seat of catarrhal pneumonia is ordinarily the posterior part of the lungs, even when it results from extension of the inflammation from the bronchial tubes. When resulting from collapse, it affects chiefly those lobules which are remote from the bronchi, and which the air enters only by a long circuit.

Catarrhal pneumonitis, when it arises from extension of acute inflammation of the bronchioles, is acute, but in those forms of the disease which supervene upon passive congestion it is subacute. The alveoli are less distended by inflammatory products than in croupous pneumonia, not only from the less amount of fibrinous exudation, but also of cells. Hence the volume of the inflamed lung is not so great as in that disease, and the torn surface, even in the adult, does not present so distinct a granular appearance. Hence, also, the stage of gray hepatization does not supervene so uniformly and regularly, since there is less compression of the capillaries in the alveolar walls, and the mutual pressure of the inflammatory products is less. In infants who have died with this form of pneumonitis, of six or eight weeks' duration, it is not unusual to find the affected lobules still in the stage of red hepatization. Cell-proliferation occurs in the bronchioles of the inflamed lung as in the alveoli, producing within them numerous plugs, which, though they ob-

struct the entrance of air, are not so firm as in croupous pneumonitis, since they contain less fibrin.

In favorable cases the lung affected by catarrhal inflammation returns to its normal state, probably by the same process as in croupous pneumonitis. In other cases, especially in scrofulous and feeble children, the inflammation, instead of resolving, passes into what is now designated cheesy, or by certain writers scrofulous, pneumonitis.

Cheesy Pneumonitis.—Cheesy degeneration of the inflammatory product occasionally occurs in the croupous form of inflammation, but it is more common in the catarrhal. I have most frequently observed it in New York during epidemics of measles, when this form of pneumonitis supervened upon the catarrhal bronchitis of that disease. Cheesy pneumonitis is in its nature chronic, and attended with great reduction of the vital powers.

Cheesy degeneration of the exudate or infiltrate consists essentially in the absorption of the liquid portion, and fatty degeneration of the solid. The obstruction of the circulation in the capillaries and the accumulation of cells in the alveoli and bronchioles which cannot be expectorated, are conditions which favor cheesy metamorphosis. The appearance and consistence of the lung when it has undergone this change are well expressed by the term which is employed to designate it. The cheesy mass consists of fatty, shrivelled, and fragmentary cells, and amorphous matter in which can be traced the elastic fibres and larger vessels of the parenchyma, the other histological elements having disappeared.

The caseous mass after a time softens, attracting moisture from the surrounding tissues. The molecular detritus and the shrivelled cells are now suspended in a liquid, and, like any dead matter, they are irritant to the surrounding lung-substance. The bronchial tube which supplies the affected lobule, and which in many instances was the starting-point of the disease, again becomes pervious, either by softening of the plug or by ulceration at a higher point upon its walls, and air is admitted, which promotes the putrefactive process and chemical changes of the caseous substance.

The lesion now described is that of pulmonary consumption, a disease not infrequent in children of two or three years. There are as yet no tubercles, but the presence of softening caseous material in the lungs very frequently leads to their development (see Art. Tuberculosis), and accordingly, before the case ends, clusters of tubercles may appear in the connective tissue and walls of the vessels of the lungs and in other organs.

In the subsequent progress of cheesy pneumonitis, if the patient live sufficiently long, more or less expectoration of the offending substance occurs, producing a cavity. Around the cavity a vascular pyogenic membrane forms, upon which granulations arise. These granulations, which produce pus abundantly, and from which small extravasations of blood are frequent, are gradually transformed into connective tissue. If the dead portion be expectorated, and there be a single small cavity, the child may recover, the empty space being finally filled up by the extension of the granulations, and the production of a cicatrix, which con-

tracts, producing a puckered appearance. Ordinarily, however, there are several centres of caseous degeneration, and several cavities resulting, which continue to enlarge by the progressive softening of the cheesy matter. Often, also, certain of the cavities intercommunicate. The bronchial glands undergo hyperplasia, and certain of them are liable, also, to become cheesy. As the disease advances, the suppuration and expectoration increase. The fatal result occurs sooner in children than in adults, and, therefore, the destructive and inflammatory lesions observed at autopsies are ordinarily not so far advanced in the former as in the latter. Other unfavorable changes may occur in the hepatized lung, but cheesy degeneration is the most common and noteworthy.

The possibility of inflating a lung which presents to the naked eye the appearance of pneumonitis, has long been regarded as a reliable sign of the presence or absence of inflammatory consolidation. The facts as regards the possibility of insufflation are these: In croupous pneumonitis, when it has passed beyond the first stage, insufflation is impossible in the lung of the child as well as adult, with the utmost force of the breath. We produce emphysema in healthy portions of the lungs, while the inflamed area is not encroached upon.

On the other hand, in catarrhal pneumonitis, which we have seen is the common form of pulmonary inflammation in children under the age of three years, and in which less distention of the air-cells by inflammatory products occurs, the lung can be inflated, except in protracted cases, but when fully inflated the solidified lobules can still be felt between the thumb and fingers. In protracted catarrhal pneumonitis, as well as in protracted collapse, which, indeed, may and often does become a pneumonitis, full inflation is impossible. Central portions still remain impervious to air. While, therefore, the possibility or impossibility of inflating a lung removed from an adult, and which presents to the naked eye the appearance of pneumonic solidification, is a valuable sign as indicating whether or not the disease be pneumonitis, this test is uncertain and unreliable when applied to the pulmonary lesions of children under the age of three years.

Symptoms.—Croupous pneumonitis commonly begins abruptly, or it is preceded for a brief period by symptoms of a cold. In the adult, the abrupt commencement is ordinarily with a chill. In the child, there is often a sensation of chilliness, but a distinct chill is not common. Convulsions sometimes occur in place of a chill. Catarrhal pneumonitis, being ordinarily a secondary disease, begins in a more gradual way, its symptoms being preceded by and associated with those of the primary affection.

The symptoms of acute pneumonitis, whether catarrhal or croupous, are the following: Anorexia, thirst, restlessness, elevation of temperature, acceleration of pulse according to the intensity of the inflammation and the feebleness of the patient, flushed face, a countenance expressive of suffering, accelerated respiration, with an expiratory moan. These symptoms are constant in the acute inflammation unless of the mildest form. Those which are important I shall explain more fully.

The expiratory moan is described by writers as a pathognomonic symptom of this disease, or of pleurisy. It is evidently due to the pain

experienced from the movement of the inflamed part. As a rule, the expiratory moan indicates either pneumonitis or simple pleuritis; but there are exceptions. It may occur, for example, from indigestible substances in the stomach and intestines, giving rise to acute dyspepsia; or from certain forms of abdominal inflammation, which render movements of the diaphragm painful, as diaphragmatic peritonitis.

The cough in the first days of pneumonitis is often dry or hacking and painful. It afterward, if the case be favorable, becomes looser, and is painless. We very seldom observe in the child the bloody sputum which characterizes pneumonitis in the adult, since in catarrhal inflammation there is much less exudation of blood-corpuscles. The sputum, which in this form of the disease is the product of secretion and cell-proliferation, is at first thin and frothy, but afterward thicker and less tenacious from the increased number of cells. There is often, in the first period of the inflammation, pretty severe and constant headache, the patient complaining of the head, if old enough to speak, before he does of the chest. In a severe attack the child at this period lies with the eyes shut, apparently in a half-conscious state, fretful if spoken to or aroused, so that the physician may be led to suspect the presence of cerebral disease. If there be vomiting, accompanied with sudden twitching of the muscles, and convulsions—symptoms which sometimes occur—the liability to error in diagnosis is greatly increased. Cerebral symptoms are more prominent in the commencement of pneumonitis than subsequently. As the disease advances they subside, and symptoms referable to the chest become more conspicuous.

The breathing is, as I have said, accelerated. Thirty or forty respirations per minute are common, and, in severe cases, the number reaches sixty or even eighty. In infants there is greater frequency of respiration than in children. In those at the breast, if the dyspnœa be urgent, nutrition is sometimes seriously interfered with, since in these severe cases respiration is performed more through the mouth than nostrils, so that if the infant seize the nipple, it is forced to relinquish it in order to breathe. Dilatation of the alæ nasi, and depression of the inframammary region, accompany inspiration. The dyspnœa in catarrhal pneumonitis is often due in great part to accompanying bronchitis.

The temperature in mild cases of pneumonitis is elevated to about 101° to 103°; in severe cases it may reach 105° or even 107°, the former being the highest observed by Mr. Squire. In ninety-seven observations made by M. Roger, the average temperature was 104° during the active period of the inflammation. The face is therefore flushed, and the heat of surface pungent, except in weakly children, in whom, even in severe and active inflammation, the face is sometimes pallid, and the extremities of natural or less than natural temperature.

The tongue is moist, and covered with a light fur; the thirst is such that nutriment may be given in the form of drinks, when the loss of appetite prevents the use of solid food. The bowels are usually constipated. The secretions, in the first and second stages, are diminished. The urine is more deeply colored than in health, and in vigorous patients it deposits urates on cooling. The chlorides are also deficient or absent from the urine, so long as the inflammation is extending.

In favorable cases, in from seven to ten days the heat and thirst decline; the pulse and respiration gradually become less frequent; the cough looser; the features have a more placid or contented expression; the appetite returns, and the patient is again amused by playthings. The improvement is progressive, but gradual. A slight cough is occasionally observed two or three weeks after convalescence is fully established.

Death in the acute stage of the inflammation commonly occurs from asthenia. The pulse gradually becomes more frequent and feeble, the respiration more oppressed, and finally, near the close of life, the face and extremities become cool. Occasionally death results from apnœa, due in great part to coexisting bronchitis. In exceptional instances it occurs from convulsions, followed by coma, especially in the first week. In those protracted cases in which the inflammatory products have undergone cheesy degeneration death occurs from asthenia.

Such are the symptoms and progress of ordinary acute pneumonitis in children. When the inflammation is subacute, as in those forms of the disease which result from collapse or hypostasis, the symptoms are less pronounced. The respiration in such cases is but moderately accelerated, is attended by little pain, and therefore the expiratory moan is often absent. An occasional short, dry cough occurs, with so little increase of temperature and quickening of the pulse that the pneumonitis is often overlooked by the physician, the symptoms being referred to bronchitis. Pleuritis seldom occurs in connection with this form of pneumonitis, except when a small abscess or gangrene results in an affected lobule directly under the pleura. A few such cases I have observed.

Tubercular pneumonitis extends over much or little of the lung according to the amount of tubercles. The symptoms are like those of severe primary pneumonitis, superadded to such as pertain to tuberculosis. This inflammation, when once established in the consumptive child, commonly continues till the close of life. I have sometimes had these cases under observation for several consecutive weeks, even months, and during the whole time there was not only acceleration of pulse and respiration, but the expiratory moan. As regards pneumonitis occurring in hooping-cough, it is an interesting fact that its symptoms modify those of the primary disease, so that, during the active period of the inflammation, the paroxysmal cough diminishes, and a short, hacking cough and expiratory moan occur in place. As the inflammation abates, the spasmodic cough returns. Pneumonitis occurring in measles is more obstinate, protracted, and dangerous than the primary form. It usually commences about the period of the decline of the eruption, and, in favorable cases, continues two or three weeks. It is then a sequel, rather than complication.

Physical Signs.—The physical signs of pneumonitis in infancy and childhood are the same as in the adult, but in a large proportion of cases they are less distinct. In a majority of patients under the age of three years the crepitant râle is not observed. This is due to the small size of the alveoli at this age. I have now and then detected it in quite young children, in whom it is a finer râle than in the adult. If observed, it is positive proof of the existence of pneumonitis. The

physical signs, therefore, in the first stage of the inflammation, are often obscure in consequence of the absence of the pathognomonic râle. The vesicular murmur is somewhat intensified through the chest, and there is at this stage slight dulness on percussion over the seat of the inflammation due to engorgement of the vessels, but it is difficult to appreciate this.

In the second stage, which supervenes more or less rapidly, the physical signs are more distinct. Bronchial respiration is in most cases detected, higher in pitch than the vesicular murmur, with the sound of expiration higher than that of inspiration. The voice of the patient is transmitted to the ear applied over the seat of the disease, and often a peculiar vibratory sensation is communicated to the hand applied over the part, so that it is possible to locate the disease by palpation alone. In the second stage, and sometimes in the first, coarse mucous râles in various parts of the chest are often observed occurring from coexisting bronchitis.

Percussion, in the second stage, elicits a dull sound as compared with that produced on the opposite side of the chest. The dulness corresponds in extent with the solidification, and with the bronchial respiration.

As the inflammation abates, the dulness on percussion gradually diminishes, and the bronchial respiration is succeeded by the subcrepitant râle. Often, for a considerable period after convalescence is established, moist râles are observed in the chest, and sometimes the dulness on percussion does not entirely disappear until the health is fully restored.

In catarrhal pneumonitis these signs are commonly less distinct than in the croupous form of inflammation. This is due in part to the limited extent of the inflammation, in part, in many cases, to its subacute character, and in part to the fact that it is in many patients double, so that we lose the aid of comparison. When it results from hypostatic congestion it is nearly always bilateral.

Diagnosis.—It will aid in diagnosis to recollect that under the age of three years pneumonitis is ordinarily catarrhal, and that it is preceded by and associated with bronchitis. Coincident with, and often preceding its development for a few days, are the usual symptoms of nasal and bronchial catarrh. Defluxion from the nostrils, and other symptoms due to "taking cold," help us to diagnosticate catarrhal pneumonitis from the essential fevers, with the exception of measles. Croupous pneumonitis begins more abruptly, but in this form of inflammation the greater extent of pulmonary solidification soon gives us clear and unmistakable physical signs. The various forms of so-called remittent fever bear considerable resemblance as regards symptoms to certain cases of pneumonic inflammation, but in the latter there are more acceleration of respiration and greater suffering, especially when the child is disturbed, than in the former. The physical signs, however, afford decisive proof of the nature of the malady, as dulness on percussion, bronchial respiration of a higher pitch and harsher than the normal vesicular respiratory sound, bronchophony, vocal fremitus, etc.

Difficulty sometimes attends the diagnosis of broncho-pneumonitis

from simple bronchitis. The presence of the expiratory moan, if it be pretty constant and marked, affords evidence that the inflammation has extended to the lungs, but the physical signs constitute the reliable means of exact diagnosis. They should be carefully noted, in order to determine if there be some point of solidification.

Solidification gives rise to dulness on percussion, bronchial respiration, and bronchophony. These three signs coexisting afford sufficient proof of pneumonitis, unless there be tubercular consolidation or possibly collapse supervening on suffocative bronchitis. The history of the case aids in determining whether there be either of these diseases. Moreover, collapse occurs later after the attack commences than hepatization, and does not produce so distinct bronchophony or bronchial respiration as is observed in ordinary cases of pneumonitis.

Pleuritis with effusion may present physical signs which bear considerable resemblance to those in pneumonia; but in pneumonia, except when associated with tubercular disease, the dulness on percussion is not so great as that from pleuritic effusion. In pleuritic effusion in a young child the respiratory murmur can often be heard with the ear applied over the liquid, but it is indistinct and transmitted through the liquid from a distance. The practised ear is able to discover the difference between it and the bronchial respiration of pneumonitis. Vocal fremitus, which is absent in pleuritic effusions, is another reliable sign of pneumonitis in children over the age of three or four years. In younger children it is indistinct. Occasionally the physical signs indicate the coexistence of the pulmonary and pleural inflammations.

In catarrhal pneumonitis it is often difficult to determine certainly the nature of the disease, since the physical signs, if there be but little extent of inflammation, are absent or indistinct. I have often, in post-mortem examinations, found so small a part of the lung hepatized that it could not possibly have produced any appreciable dulness on percussion, bronchial respiration, or bronchophony. Such cases often pass for simple bronchitis, and, practically, this matters little, since the treatment required by the two is not dissimilar.

Prognosis.—Primary pneumonitis, affecting only one lung, if properly treated, in most instances terminates favorably in children, and even in infants. If double, it is, as in the adult, much more serious, and in a large proportion of cases fatal. Secondary pneumonitis, pneumonitis occurring in measles, hooping-cough, tuberculosis, or resulting from hypostatic congestion in the course of some exhausting disease, is, on the other hand, more frequently fatal. As death usually occurs from asthenia, the younger the child and more feeble the constitution, the greater the danger.

Unfavorable symptoms are a pulse becoming more and more frequent and feeble, pallor of countenance, inability of the patient to support the head, total loss of appetite, refusal to notice or be amused by playthings, absence of tears when crying—a symptom which French writers have pointed out—and the appearance of pemphigus on the face or elsewhere.

Indications on which a favorable prognosis may be based are moderate acceleration of pulse, pneumonitis primary and limited to one side, ability to support the head or sit erect, being amused by playthings, etc.

TREATMENT.—The treatment of the two forms of pneumonitis, namely, catarrhal and croupous, the former occurring chiefly under the age of three years, and being secondary, the latter occurring in most patients over that age, requires to be considered separately as much as do their symptoms and anatomical characters.

Catarrhal pneumonitis when developed from and upon a bronchitis, as it so often is, requires for the most part the continuance of the remedies which are appropriate for the primary disease. (See Art. Bronchitis.) But from the fact that it is secondary, and in children of tender age, and since the danger as regards the pneumonitis is due to asthenia, more actively sustaining measures are demanded than are required for uncomplicated bronchitis. When the pneumonitis has continued a few days, and often in its commencement, carbonate of ammonium and alcoholic stimulants are needed, and the diet from the first should be nutritious. An opiate, as the compound tincture of ipecacuanha, should be added to the cough-mixture, if there be restlessness or insufficient sleep, and the external treatment recommended for bronchitis should be continued. In that form of catarrhal pneumonitis which is due to passive congestion or hypostasis, in the causation of which debility is an important factor, tonic and stimulating measures are still more imperatively required. Frequent change of position is useful in such cases.

In *croupous* pneumonitis, if seen at the commencement or within a few hours of the commencement, an emetic of ipecacuanha may be given, as recommended by Trousseau. This acts promptly as a cardiac sedative, diminishing somewhat the afflux of blood to the lungs, and moderating the inflammation. It should not be employed except at the period mentioned.

The abstraction of blood by leeches or otherwise has justly fallen into disrepute in the treatment of the inflammations of children, since it is too depressing. But while the application of leeches in catarrhal pneumonitis is very rarely admissible, on account of the tender age of the patient and the secondary character of the inflammation, they may be useful in robust children with croupous pneumonitis, if applied sufficiently early, namely, within the first twelve hours. Two leeches are sufficient for a child of five years. When solidification of the lung has occurred, the time for the abstraction of blood is past. But we have in aconite and veratrum viride efficient substitutes for bloodletting, which, by their sedative effect on the heart, diminish the exaggerated afflux of blood to the inflamed lung, and thus enable us to meet the indication of treatment in the first stage of the inflammation. It is important in all severe cases to preserve the blood and the strength, for the danger in the end is chiefly from asthenia. Aconite as a cardiac sedative in the treatment of children is safer than veratrum viride; it is not necessary to watch its effects so carefully.

The following will be found a useful formula for a child of five years in the commencement of pneumonia:

℞.—Tinc. ipecac. comp. (Squibb's) . . . . . gtt. xxxij.
Tinct. rad. aconit. . . . . gtt. xvj.
Syr. bal. tolut.
Aquæ . . . . . āā ℥j.

Dose, one teaspoonful every three hours; or the aconite may be given alone, dropped in sweetened water or syrup of tolu.

If bronchial respiration, bronchophony, and dulness on percussion are present, indicating the second stage; in other words, if it appear from the signs that the inflamed lobe or lobes are hepatized, little benefit accrues from the further use of aconite or veratrum viride, and harm may result. In this stage the above prescription, with the aconite omitted, may be continued, or the following may be employed:

℞ —Morph. sulphat. . . . . gr. j.
Syr. ipecacuanhæ . . . . . ℥ss.
Syr. bal. tolut. . . . . ℥iijss.—Misce.

Dose, one teaspoonful every three hours to a child of five years.

The remarks made in reference to the use of quinia and digitalis for bronchitis apply with still more force to their use in both the catarrhal and croupous forms of pneumonitis. In secondary pneumonitis and in primary occurring in feeble children these agents are in many instances preferable to any other medicine for the purpose of reducing the temperature and pulse, since they produce this result without depression. They may be administered in such cases from the first day, and their use may obviously be continued longer than would be safe for aconite or veratrum viride.

From some observations recently made (1880–1881) in the New York Foundling Asylum, it seemed to us probable that quinine, given in one or two large doses at the commencement of acute primary pneumonitis, as five grains to a child of three years, exerts some controlling effect on the inflammation, perhaps even rendering it abortive, and that its subsequent use in smaller doses may yet supersede in great part that of aconite and veratrum viride.

When the inflammation begins to abate there is usually progressive improvement. Many now recover with simple mucilaginous drinks or mild expectorants useful for the accompanying bronchitis, as syrup of ipecacuanha or squills in small doses. Others require more sustaining measures, and for such carbonate of ammonium is preferable with, perhaps, quinia. In severe pneumonitis it is of the utmost importance to sustain the vital powers, even from the commencement of the inflammation. There can be no doubt that the great error in the therapeutic management of children with this malady has been the employment of medicines which reduce the strength when gentler measures or those of a sustaining nature were needed. Alcoholic stimulants are required sooner or later in most cases, at an early period in feeble children and in secondary forms of the inflammation. Infants may take three or four drops of Bourbon whiskey or brandy for each month of their age every two or three hours. The diet should be nutritious, consisting of milk, animal broths, and the like, unless during the first three or four days in robust children.

The bowels should be kept open, as an important part of the treatment of croupous pneumonitis in its first stages. A small dose of castor oil, Rochelle salts, or citrate of magnesium should be given if there be any tendency to constipation, and repeated from time to time if required. A saline aperient by its derivative and refrigerant effect in some cases obviates the necessity of employing cardiac sedatives. A laxative enema is preferable for a feeble child, and in most cases of secondary pneumonitis.

Local treatment is required in all cases; counter-irritation should be produced as soon as possible over the inflamed lobe, by mustard, iodine, or some stimulating liniment, and, except at the time of this application, the chest should be constantly covered with an emollient poultice, or with a cloth wrung out of warm water and covered with oil-silk. I prefer, however, the constant application, under the oil-silk, of the following poultice, made large, but as thin as the pasteboard cover of a book, and therefore light:

℞.—Pulv. sinapis. . . . . ℥ss.
Pulv. semin. lini . . . . . ℥viij.—Misce.

Vesication, in my opinion, very rarely expedites the cure or benefits the patient. The ordinary fly-blister should never be employed; and if it be thought best to vesicate, cantharidal collodion should be prescribed for this purpose. A safe, almost painless, and at the same time efficient, mode of applying this, is in spots as large as a ten-cent piece, half a dozen, more or fewer according to the extent of the inflammation, the skin of course remaining sound between them. This mode of application obviates the danger of producing a troublesome sore, which sometimes occurs in children from the ordinary mode of vesication.

In *cheesy* pneumonitis, which is always accompanied by anæmia, and great reduction of the vital powers, carbonate of ammonium with citrate of iron and ammonium equal parts, or cod-liver oil administered three times daily with two drops or more of syrup of iodide of iron, will be found useful, as is also quinine with iron. Patients require the most nutritious diet and alcoholic stimulants. In the local treatment of this form of inflammation vesication, even so mild as that by cantharidal collodion, should be avoided.

CHAPTER VII.

PLEURITIS.[1]

The term pleuritis or pleurisy is employed, in this chapter, to designate inflammation of the pleura, when not produced by extension of the inflammatory process from the lung, or by the irritation of tubercles upon or under the pleura. Catarrhal pneumonia, common in

[1] From the New York Obstetric Journal, 1880–1881.

infancy; croupous pneumonia, common in childhood; pulmonary tuberculosis, not rare in both periods in wasted and cachectic children, are ordinarily accompanied by pleurisy, arising consecutively to the lung disease, and limited nearly to the portion of the pleura which covers the affected lobes or lobules. But since in these cases the pleuritis is subordinate to and dependent on the graver diseases, and is comparatively unimportant, it does not require separate consideration. It is properly treated of in our books in connection with and as a part of those diseases. All other cases of pleuritic inflammation, although presenting wide differences in form and clinical history, are embraced under the general term *pleuritis*.

Pleuritis: its frequency.—Pleuritis was formerly supposed to be rare in young children. Even M. Barrier, of Lyons, the author of a creditable treatise on diseases of children, wrote as late as 1860: "Ainsi donc, en généralisant les faits de Vallieux et les nôtres, nous pouvons dire: que la pleurisie, depuis la naissance jusqu'à l'age de six ans environs, ne constitue presque jamais une affection simple, unique, et independante de la pneumonie." But greater precision in the examination of cases, more accurate means of diagnosis, more knowledge of the nature of diseases, and more frequent autopsies have enabled the profession to correct this, as well as many other errors; and it is now known that primary pleurisy is not infrequent in young children, even in infants. In asylums and hospitals for children, in which institutions the nature of diseases is more accurately ascertained than in private practice—for autopsies are made in the fatal cases—the frequency of pleurisy in its various forms: latent, semi-fibrinous, and purulent, is surprising to those whose knowledge of the disease has been acquired only through private practice. Thus, in the New York Foundling Asylum, in the seven months from April 1 to November 1, 1879, while there were 35 cases of bronchitis, 21 of pneumonia, and 3 of tuberculosis, there were 11 clearly ascertained cases of pleurisy. There can be no doubt that many cases of this malady in young children are mistaken by good practitioners for other diseases, especially for pneumonia, or, if the pleurisy be to a certain extent latent, for remittent or malarial fever, or fever due to intestinal irritation. I have records of several cases occurring in family and hospital or asylum practice, in which children perished with a wrong diagnosis, or without diagnosis, when the post-mortem examination revealed pleurisy, sometimes of long standing. Thus in one case of fatal empyema, commencing at the age of six months, and continuing several months, chronic pneumonia had been diagnosticated by physicians known to be thorough in their examinations, and usually accurate. In another case, which proved fatal at about the age of one year, the child, who lived in a malarial locality, had been for weeks under treatment for supposed malarial disease; but in this case diagnosis was easy, for at my first visit, which was when the child was dying, there was decided dulness on percussion over the right side of the chest. In this case, the right lung was adherent to the ribs anteriorly and laterally, while posteriorly it was separated by pus, which crowded forward the organ, so that its posterior surface was concave.

In wards of institutions and in the crowded quarters of the poor, pleurisy appears to be more frequent than in families in comfortable circumstances. Its frequency varies, also, in different years, according to the presence and prevalence of its causes. Thus, during epidemics of scarlet fever, it is more common than at other times.

During several weeks immediately preceding May, 1874, when there was no unusual prevalence of the causes or conditions which give rise to pleurisy, I noted carefully the character of the sickness in 404 consecutive cases, under the age of twelve years, in private practice, and of these, two had primary pleurisy, or one-half per cent. This is probably about the usual proportion of pleurisies in children in family practice, except when scarlet fever is prevalent.

I have preserved the records of 56 cases of pleurisy in children under the ages of twelve years, most of them occurring in the institutions which I am attending, or have attended as physician, and the remainder in private practice. The statistics of these cases, embraced in the following table, are interesting, as showing the frequency of pleurisy, and pleurisy of the suppurative form, in young children. The large number of empyemas seen in the table does not, however, indicate the true proportion of suppurative to sero-fibrinous pleurisies, since protracted and stubborn cases, which are largely empyemas, are more frequently brought to institutions for treatment than are those of a milder and more manageable type. Thus, in the class of children's diseases in the Bureau for the Relief of the Outdoor Poor, a large percentage of the cases are empyemas which have resisted treatment elsewhere. Besides, pleurisy with little exudation is sometimes latent or so mild that it is overlooked or not diagnosticated, even by physicians who are thorough and careful in their examinations, and I do not doubt that such cases have occurred in the institutions and in my private practice during the time in which my statistics were collected.

Age. 49 *Cases.*

Under 2 Mos.	From 2 to 6 Mos.	From 6 to 12 Mos.	From 1 Yr. to 3 Yrs.	From 3 Yrs. to 6 Yrs.	Over 6 Yrs.
3; all empyemas; one double.	15; nine at least empyemas; seven on right side, four on left side, four double.	2; both empyemas; one right, the other left.	13; eight right, five left. Exudation in some sero-fibrinous; in others purulent.	10; seven right, three left. Exudation in some sero-fibrinous; in others purulent.	6; five right, one left, one empyema.

Causes.—The common cause of primary pleuritis is the same as that of other idiopathic inflammations, namely, "taking cold." It is, therefore, most common in times of changeable temperature. Cachexia is an acknowledged predisposing cause, so that children whose blood is impoverished, whether from previous disease or from anti-hygienic influences, are more liable to this inflammation than those who possess a sound and vigorous constitution. From the operations of these two

causes a larger proportion of cases occur among the children of the city poor than among those who are well nourished and who live in comfortable circumstances, since the cachectic and ill-cared for are not only more exposed, but are less able to resist noxious agencies.

Pleurisy is not rare in newborn infants, and its cause, when thus occurring, is not always apparent. It may sometimes be heedless exposurs to cold or to currents of air by the nurse, but the common cause at this age is believed to be the absorption of septic matter.

Billard, whose observations were made among foundlings in the Hospice des Enfants Trouvés, says: "Pleurisy is more common among young infants than is generally supposed; it often appears without the lungs participating in the inflammation. I have seen several infants die immediately after birth from this affection." He relates two cases of double idiopathic pleuritis ending fatally at the ages of two and ten days (*Diseases of Infants*, page 419). Mignot, whose observations were made in the same institution, also records ten pleurisies, five of which were idiopathic, in 119 dissections of newborn infants (*Maladies pendant le Premier Age*).

Cases like the following are not infrequent:

In 1867, I made the post-mortem examination of a foundling who died in the New York Infant Asylum, at the age of about one month. On each side of the thorax, the pleura, costal and pulmonary, was uniformly injected, and a small amount of pus, not more than one drachm, was found in one pleural cavity, and a still less quantity of pus in the other, with little or no sero-fibrinous exudation. There was also pus at the root of each lung, lying not entirely upon the free surface of the pleura, but partly underneath it.

The fact of a double pleurisy without disease of the lungs, which might produce it, indicated a constitutional cause. Its system had probably become infected by the absorption of septic matter from the umbilical vessels.

One of the eruptive fevers, scarlatina, not infrequently produces pleuritis, occurring as a complication or sequel. This result seems to be sometimes due to the altered state of the blood, resulting from the presence of the scarlatinous virus. In other instances it is probably the result of retained urea, consequent on scarlatinous nephritis, for pleuritis is a common complication of Bright's disease, due, it is supposed, to the irritating property of urea, which is excreted upon the pleural surface. Pleuritis, in young children, is sometimes also caused by the discharge into the pleural cavity of some morbid product, as pus, softened tubercle, or decomposed lung-tissue, which, from its highly irritating effect, causes intense and general inflammation of the pleura. I have observed several such cases.

Thus, in November, 1866, an infant of three and a half months died of pleurisy, occurring upon the left side. The left lung was firmly bound down by adhesions, so as to be reduced to about one-sixth its normal size. On attempting inflation of this organ, when it was removed from the body, air escaped from a small opening in the middle of the upper

lobe, and around this opening the lung-substance was of a dark reddish color, softened and disintegrated. It seemed probable from the appearance that there had been hypostatic congestion, or perhaps pneumonia, in the posterior part of the lung, and that the loss of vitality and softening had occurred from the sluggish or suspended circulation in the part, and that the fatal pleurisy had resulted from a little of this decomposed tissue entering the pleural cavity.

A case having apparently a similar origin occurred in the New York Foundling Asylum in October, 1879.

An infant, aged five months and a half, became suddenly and severely sick with pleurisy on the right side, and died in five days. On opening the pleural cavity, air escaped. The record of the examination states: "In about the middle of the posterior surface of the lower lobe was an opening which admitted the tip of the little finger to the depth of one-fourth to one-third inch. The lung-tissue seemed to be disorganized, and of pultaceous consistence around the cavity. Through this cavity, which communicated with a bronchial tube, the air had escaped, which was noticed on opening the chest."

Occasionally we meet cases, especially in foundling asylums, in which the cause is different from the foregoing, but in some respects similar. An indolent pneumonitis occurs over a circumscribed area in the posterior part of the lung, either from hypostasis or exposure to cold. Minute abscesses form in the inflamed parenchyma, not larger than pins' heads or small shot. Perhaps they are located in bronchioles, and are produced by the accumulation of muco-pus which collects in these tubes, and is not expectorated on account of the low vitality and feeble functional activity of the tissues concerned. These abscesses approaching the pleural surface produce a circumscribed pleuritis of small extent; and finally one, probably in some sudden movement of the lungs, as in crying or coughing, breaks into the pleural cavity, causing general purulent inflammation. The following was such a case:

In May, 1859, a male infant, aged two months, was admitted into the Nursery and Child's Hospital. He was delicate, and had what was diagnosticated a mild bronchial catarrh; but by wet-nursing his general condition gradually improved. In July, however, he had repeated attacks of diarrhœa, and progressively lost flesh and strength. On August 3d his respiration became suddenly accelerated and painful, and death occurred from dyspnœa and exhaustion. No cough or other symptoms referable to the respiratory apparatus had been observed previously to the day of death.

At the autopsy the intestines were found to present the usual lesions of intestinal catarrh of the summer season. The right lung was compressed by a sero-fibrinous exudation, though, from the small size of the pleural cavity, the quantity of exuded liquid was not more than two ounces. Nearly the entire right pleura, visceral and parietal, was covered with fibrin of a creamy appearance, and there were loose flocculi in depending portions of the cavity. This lung could be inflated, except a little of the lower lobe, which was hepatized. The left lung also occupied a very small space, being partially collapsed. It could be readily inflated, when it ap-

peared normal, except a small portion in the posterior aspect of the lower lobe, which was partially covered with lymph, and was found to contain two abscesses, one closed and the other opening externally on the surface of the lung, and connecting internally with the bronchial tube. On attempting inflation, air passed directly through this opening. The closed abscess contained from one-third to one-half a drachm of pus and disintegrated lung-tissue, as shown by the microscope.

Another case showing a similar cause of pleurisy occurred in a female infant of about four months, in the same institution, in November, 1869.

She was admitted in October, somewhat reduced from diarrhœa, but her health improved partially, though she remained feeble, and the records state that she was much troubled with meteorism and occasional pain. On November 2d, she was suddenly seized with great dyspnœa, and died in about fifteen minutes. No cough had been noticed or other symptom referable to the chest, but there can be little doubt that the occasional symptoms of pain, referred to in the notes, were due to the pleurisy. The body was much emaciated, and depending portions showed hypostatic congestion; right lung adherent to diaphragm and to a considerable part of the costal pleura by fibrinous exudation; this lung was somewhat compressed and non-crepitant; its upper lobe floated in water, while its middle and lower lobes sank, and could be only partially inflated; this portion of the lung contained a few small superficial abscesses, each holding scarcely more than one drop of pus; two of these were empty, and air passed through them on attempting inflation. They probably one or both opened into the pleural cavity during life, but possibly they were opened in separating the adhesions which united the two pleural surfaces at this point; the pleural cavity contained from two to three ounces of liquid, consisting mainly of pus and fibrinous shreds.

A similar case occurred in the New York Foundling Asylum, in October, 1879.

The patient, aged four months, began to be sick October 11th, having the characteristic symptoms, and died October 15th. The right pleural cavity contained about ʒiij of sero-purulent liquid, pressing the lung forward and toward the median line. In the posterior surface of the right lower lobe, near its base and immediately under the pleura, were three or four small abscesses, each not larger than a small drop of pus, and two or perhaps three of these had ruptured, so that air escaped from them on attempting inflation, while one was closed, the pus in it being visible under the pleura.

This cause of pleurisy, namely, the bursting of a minute abscess in the lung, and that in which a portion of the lung loses its vitality, disintegrates, and enters the pleural cavity, are probably rare, except in the first months of infancy in wasted and ill-conditioned infants, in families of the city poor and in the asylums.

A peri-pharyngeal abscess, descending along the œsophagus, has been known to cause fatal pleuritis by bursting into the pleural cavity, and pus from carious vertebræ has produced the same result. In January,

1864, I presented to the New York Pathological Society the lungs of an infant whose history was as follows:

R., aged nine months, of strumous parentage, and whose only sister had suffered severely from strumous ophthalmia and periostitis, was taken sick about December 19, 1863, with febrile movement, attended by restlessness, but apparently without any serious indisposition. On the 22d, the mother called my attention to a prominence just below the right clavicle, which proved to be an abscess, and a poultice was applied over it. On the 24th, the prominence suddenly subsided, and immediately the symptoms were greatly aggravated. The pulse rose to 160 per minute, the respiration from 60 to 80, and expiration was accompanied by a moan, indicating acute pleuritic or pulmonary inflammation. Within forty-eight hours after the disappearance of the swelling, and the exacerbation of symptoms, dulness on percussion over the right side of the chest was observed, and this increased till it was complete from the clavicle to the base of the thorax. The acceleration of pulse and respiration continued, the patient grew more and more feeble, and death occurred December 31st.

On dissecting away the integument from the right side of the chest, an abscess was opened, containing nearly one ounce of pus, located at the point where the tumor had been observed. At the base of this abscess, between two of the ribs, was a small, round opening, not much larger than a knitting-needle, leading directly into the cavity of the chest, so that on depressing the ribs liquid flowed back from the pleural cavity. On removing the sternum the liquid was found to be sero-fibrinous, with considerable pus in depending portions of the cavity.

I have met one other, apparently almost identical case, occurring in an infant of seven months.

Pleurisy in the adult is sometimes the result of violence. The most notable and unequivocal cases, having this origin, are those in which the ribs are fractured. It rarely happens that we can attribute the pleurisy of children to this cause. I can recollect only one case in which the inflammation seemed to be due to violence.

In September, 1867, an infant of twenty-two months, in the Almshouse on Blackwell's Island, having had a cough for half a year, and being somewhat reduced, fell from bed, striking against the left side of the thorax. Severe pleuritic symptoms supervened, and the child died of empyema in three and a half weeks. More than a pint of pus was found in the left pleural cavity, pressing the heart beyond the median line, and the diaphragm downward, so that it was convex toward the abdomen. The bronchial glands were hyperplastic and slightly cheesy, and a caseous nodule lay in the anterior surface of the right lung, which seemed otherwise healthy. The left lung bound down by adhesions could be partially inflated. Whether or not it contained small tubercles is not stated in the records.

The occurrence of the injury just before the commencement of the pleurisy may indeed have been a coincidence, but the mother constantly believed that the fall caused the inflammation, and there was no other assignable cause.

It is probable, from the history of this case and the lesions, that the

cheesy degenerations antedated the fall, and that the pleura was in an abnormal state and prone to inflammation when the injury was received.

The etiology of pleurisy in children differs, therefore, from that in adults. Certain causes are the same; but others, as scarlet fever, and irritating products generated in the walls of the chest and bursting into the pleural cavity, are not rare in infancy and childhood, while they seldom occur in adults.

Anatomical Characters.—In the commencement of pleuritis, the subpleural bloodvessels, lying in the connective tissue, and the capillaries of the pleura are engorged with blood, producing vascular points and arborescence, seen through a magnifying-glass of low power. Frequently, in children as in adults, minute extravasations of blood, resulting from extreme congestion, occur under the endothelial layer, perhaps scarcely perceived by the naked eye, but readily seen under the glass. Immediately exudation of liquid, holding numerous cells, begins in the connective tissue which surrounds the capillaries, the pleura becomes dry and lustreless, while the production and exfoliation of its endothelial cells are greatly increased. These no longer present their normal appearance, but are swollen and granular, in consequence of the inflammation.

Immediately after these parenchymatous changes occur, serum, fibrinogenic substance, and leucocytes begin to exude upon the free surface of the pleura. The term fibrinogenic substance, instead of fibrin, is employed, because it is now believed that fibrin itself is not exuded, but a substance which becomes fibrin, through the presence and action of certain agents with which it comes in contact, among which may be mentioned air, red blood-corpuscles, and even serum, from which fibrin has been precipitated (Virchow, Cornil, Ranvier, and others).

In the exuded liquid, even if it have the appearance to the naked eye of ordinary serum, the microscope always reveals the presence of pus-cells or leucocytes, and red blood-cells, however small their quantity may be. The minute rootlets of the lymphatic system, which are interspaces or lacunæ in the subpleural connective tissue, and which, here and there, open by stomata upon the pleural surface, are clogged by inflammatory products, and their walls swollen at an early stage (E. Wagner and others). In these lymphatic channels, both pus-cells and coagulated fibrin are seen by the microscope. That pneumonitis, whether catarrhal or croupous, seldom occurs in superficial parts of the lungs without causing inflammation of that portion of the pleura which covers the affected lobules is universally known; but the reverse is also true, that pleurisy seldom occurs without causing inflammation of the alveoli which are adjacent to the inflamed membrane. The pneumonitis thus caused is so superficial that it is very liable to be overlooked at the post-mortem examination, in the presence of the graver lesions of the pleura; but a knowledge of its occurrence is important in diagnosis, for, though it may have no greater depth than a line, it is sufficient to produce crepitant râles, like those in ordinary pneumonitis. Therefore, if we hear these râles, we may mistake the disease for pulmonary inflammation and overlook the pleuritis—an error not unusual in the treatment of children. Trousseau, who surpassed most of his contempo-

raries as a clinical observer, wrote: "This sound, which is met with in the great majority of cases of pleurisy, is in fact a crepitant râle, and I have called it a crepitant râle of pleurisy. My interpretation is very simple. Just as we never have erysipelas without engorgement of the cellular tissue, there cannot be erysipelas of the pleura or pleurisy without an irritative engorgement of the subpleural cellular tissue or of the peripheric pulmonary parenchyma. This fluxion naturally carries with it into the pulmonary vesicles a serous exudation. . . . We also meet with a fine subcrepitant râle, which is very often heard quite at the beginning of pleurisy, and which likewise nearly always continues for some weeks." More recent observers and writers fully agree with the statement of Trousseau, except that what he designates irritative engorgement the microscope shows to be a true inflammation of the pulmonary alveoli.

There are four constituents of every pleuritic exudation, namely, serum, fibrin, red blood-corpuscles, and leucocytes or pus-cells, which last are identical, in appearance, with the white blood-corpuscles and the lymph-corpuscles, and the origin of which has been investigated by many microscopists. It is convenient to classify cases of pleuritis according to the quantity and relative proportion of these constituents as follows: 1st. The plastic, sometimes designated dry or adhesive. 2d. The sero-fibrinous. 3d. The purulent. 4th. The hemorrhagic. In cases which pertain to the first group, the inflammation is chiefly parenchymatous, either no exudation occurring upon the free surface of the pleura, or if any, whether fibrin, pus, or serum, it is so slight that it possesses no clinical importance. The essential anatomical changes in this form of pleuritis, as regards the pleural surface, are rapid proliferation, retrogressive change, or decay and exfoliation of the endothelial cells, and the sprouting out of granulations which develop into connective tissue. In plastic pleuritis, there is no compression of the lungs, and the pleural surfaces are separated from each other only by the granulations which soon unite with those of the opposite surface. This form of pleuritis is not infrequently latent in children, for at the autopsies of those who have died of various diseases we often observe bands of connective tissue, uniting the opposite pleural surfaces, when the parents or nurses cannot recall to mind any sickness or symptoms, such as pleuritis commonly causes. It is certain, also, that plastic pleuritis is often overlooked, when not latent; the fever and other symptoms being attributed to causes quite distinct from the true one. The symptoms and physical signs are obviously less pronounced in this than in other forms of pleuritis.

2d. Sero-fibrinous Pleuritis.—This is the most frequent of all. It is the pleuritis which commonly results from catching cold. The serum exudes from the capillaries of the inflamed pleura in very variable quantity in different cases, and the pleural surface is soon covered with a fibrinous layer. This may be a mere film, or it may attain the thickness of half an inch or more. It is usually at first slightly attached, but afterward, from being blended with the granulations, it may be firmly adherent. In some cases it is quite compact, while in others it has a loose areolar texture, containing in its interstices serum and pus-

cells. The fibrin is for the most part deposited on the pleura, but shreds and flakes of it also float in the serum. In the serum, as well as entangled in the fibrin, we find not only red blood-cells and leucocytes, but endothelial cells thrown off from the pleura which, as well as those still adherent, are almost always in process of degeneration and decay.

If a perpendicular section be made through the pleura, in this as well as in the other forms of pleuritis, many newly formed cells, the lymph-corpuscles, are observed in the meshes of the subpleural connective tissue, and, as we examine the section nearer to the surface of the pleura, these cells are seen to be aggregated in masses, and held together by a structureless, homogeneous matrix. The lymph-corpuscles appear to be the active agents in the formation of granulations. They are observed in various stages of transformation, from the round to the spindle-shaped. The prolongations of the spindle-shaped cells unite with each other, so as to form the connective tissue, capillaries, and other elements of the granulating surface. That the endothelial cells take no part in the production of the new tissue is inferred from the fact that most of them present the appearance of retrogressive change and decay. The granulations, as they sprout out from the pleura, become intimately blended with the fibrinous exudation, and when the effused liquid is absorbed, they unite with those of the opposite pleural surface, forming an organic union, by bloodvessels and nerves, between the lung and parietes, the lung and pericardium, or different lobes of the same lung, as the case may be. They pass, in two or three weeks, from embryonic to perfect tissue, vessels and nerves grow in them, and they possess, henceforth, all the properties of living tissues; they are able to absorb; they are liable to inflammation and hemorrhage, and may, in fine, participate in all the alterations of the organism of which they are a part. (Jaccoud.)

3d. Purulent Pleuritis.—Although, as stated above, pus-cells are always present in the pleuritic exudation, we designate the disease purulent or empyema when the cells are so numerous as to render the liquid turbid. If there be cloudiness, appreciable to the naked eye, and due to the pus-cells, the case is regarded as one of this form of pleuritis. Purulent pleuritis is, at first, in a large proportion of cases, sero-fibrinous, becoming purulent after some days or weeks—a fact readily ascertained by the use of the hypodermic syringe at different periods. In other instances, the pleuritis is purulent from the first. Pleuritis is, in family and in hospital practice, more frequently purulent in children than in adults, and in ill-conditioned children than in those who are robust. It is, therefore, apt to be purulent in one who has had an exhausting disease, as scarlet fever, and in the cachectic children, who reside in or are brought to institutions for treatment. Thus, in the New York Foundling Asylum, in 1879, an infant, aged two months and three days, became feverish, and had the expiratory moan and hurried respiration characteristic of pleuritis. On the fourth day, Dr. Reynolds, who was in attendance, inserted the hypodermic syringe and filled it with thin pus. This was, apparently, a case of primary idiopathic empyema. Pleuritis is purulent when it is produced by the

entrance of some irritating substance into the pleural cavity, as pus or decomposed lung-tissue.

The production of pus in the pleural cavity is often surprisingly rapid, for, when many ounces have been removed by the aspirator, nearly the original quantity is sometimes restored within two or three days. As Fraentzel says, it does not seem possible that so many pus-cells, which must surpass in number the aggregate of the white blood-corpuscles, could wander from the bloodvessels in so short a time, so that we must look for some other source of the immense production of leucocytes, in addition to that discovered by Cohnheim. A large part of the pus-cells is, in all probability, produced by rapid segmentation of the lymph-corpuscles. In two cases of purulent pleuritis, both infants, I found pus underlying the pleura near the hilus, without apparently any loss of integrity in the pleura, in such quantity that it was immediately recognized by the naked eye. Pus under the pleura, as well as within the pleural cavity, was apparently due to unusual violence in the inflammation, and rapid production of leucocytes.

Hemorrhagic Pleuritis.—This is not common. I recall but one case in a child, in whom the pleuritis occurred as a sequel of scarlet fever. The fluid several times removed by the aspirator had a deep reddish-brown color. I was apprehensive that the point of the aspirator, by wounding the granulations, had caused the hemorrhage which stained the pus removed at each subsequent operation. But, with the care exercised, and the great amount of blood-stained exudation, it seems almost certain that this was not the true explanation, and that it was a genuine case of hemorrhagic pleuritis.

Hemorrhagic exudation in the pleuritis of children is sometimes due to purpura hemorrhagica, being like the other hemorrhages a symptom of the general disease. In other cases it signalizes the commencement of a new inflammation in the vascular granulations of a previous pleuritis. Occurring under such circumstances, it is due to the increased fluxion in the numerous delicate capillaries of the granulations. Pleuritis due to cancerous or tubercular formations in or upon the pleura is sometimes also hemorrhagic. Jaccoud says: "A sero-fibrinous or purulent exudation may be red by the transudation of hematin, without true hemorrhage . . . ; the red exudations which have been observed in scorbutus and marsh cachexia are really due to these pseudo-hemorrhages." In those cases in which there is true hemorrhage, it is still uncertain whether rupture of the capillaries or a transudation ordinarily occurs, or whether the blood-cells may not escape in both modes.

A liquid pleuritic exudation, whether sero-fibrinous or purulent, obviously produces an important mechanical effect from its location. In young children, especially those enfeebled by sickness, the expansive power of the lung is slight, so that it readily yields to pressure applied to its surface, and becomes more and more compressed as the liquid accumulates. Except when retained by adhesions, the lung is pressed toward the mediastinum, and at the same time carried forward and upward. Patients with pleuritis usually lie on the back and affected side, so that gravitation determines to a considerable extent in what part of the pleural cavity the liquid will collect. In the considerable

number of post-mortem examinations which I have witnessed of children who perished from pleuritis, chiefly empyema, the lung was usually attached anteriorly to the thorax from the mediastinum outward, as far as the costo-chondral articulations, or further, except in the lower part of the cavity, where there were no adhesions, or adhesions only near the mediastinum. There were also attachments along the mediastinum, and attachments more or less firm on all sides, anteriorly, laterally, and posteriorly in the upper part of the pleural cavity, toward which the lung was compressed. Many variations occur, depending on the amount of liquid and the extent of the adhesions; but judging from autopsies which I have seen, I would say that, in the average, in cases so severe that the question of operative interference arises, if we draw a line from the axilla downward and forward to the epigastrium, the lung is adherent to the thorax over the space anterior and internal to this line, while external and posterior to it the liquid separates the lung from the ribs. This fact is important, as indicating the proper point for puncturing the chest, namely, below the lower angle of the scapula, and between the eighth and ninth ribs. One reason why the earlier performers of thoracentesis were so unsuccessful was that they selected the anterior wall of the chest as the point of operation. Nowadays, however, no one would be justified in performing thoracentesis unless he first employed the hypodermic syringe and removed fluid at the point which he selects for the puncture. The statistics of Mohr, relating to lung displacement in empyema, chiefly statistics of adult cases, are somewhat different from my general recollection of cases occurring in infancy and childhood as stated above. In 23 cases he found the lung free from adhesions, and compressed against the vertebral column and the mediastinum; in 13 cases the organ was compressed from below upward; in 1 from above downward; in 4 from within outward; in 4 from behind forward, and in 4 from before backward. These variations depend on the adhesions which the lung happens to contract. Perhaps a point a little external to the perpendicular, passing through the angle of the scapula, is preferable for puncture, as I have known the lung to be adherent to the posterior wall of the chest near the mediastinum, when the portion further removed, say two inches from the median line, was separated by interposed liquid.

Sometimes the liquid is collected in multilocular cavities formed by the connective tissue, and these frequently intercommunicate. Exceptionally in children, as in the adult cases observed by Mohr, when there has been a large and rapid liquid exudation, or when the disease has been violent and of short duration, adhesions do not occur.

On account of the great difference in the size of the pleural cavity at different ages during infancy and childhood, the amount of liquid which produces that degree of compression of the lung which materially impairs its function, varies greatly. At the age of four months, three ounces produce complete collapse of lung, so that it resembles a fleshy mass (carnification). The largest amount of liquid relatively to the size of the chest, in any of the cases which I have observed, was about one and one-half pints, in the left pleural cavity in an infant that died at the age of twenty-two months, in September, 1867. The heart lay

chiefly to the right of the median line, and the diaphragm was convex toward the abdominal cavity. The case occurred in the Almshouse on Blackwell's Island, and might in all probability have been relieved had attention been directed to it sufficiently early.

Liquid in the left pleural cavity, when considerable, presses the heart toward the mediastinum, so that the apex beat, instead of being a little internal to the linea mammalis, approaches the sternum. As the heart is carried to the right, the beat is felt under the lower end of the sternum, and with still greater increase in the effusion, the pulsation is detected by the finger, to the right of the sternum. If the exudation be on the right side, the displacement of the heart toward the left is, for obvious reasons, less than the displacement toward the right, in pleuritis of the left side. Much external pressure upon the heart embarrasses its movements, and prevents proper filling of its cavities, while the action of the organ is accelerated so as to compensate. Therefore, the pulse is quick and feeble.

In one instance in my practice, the lower extremities, and the portion of the trunk below the thorax, became œdematous, from compression of the ascending vena cava, and writers allude to cases in which other vessels and ducts, as the thoracic, were compressed, so as seriously to embarrass their functions. The patient with the œdema was a boy of about four years, with empyema of the left side.

In large effusion, the mediastinum is pressed against the healthy lung so as to diminish its transverse diameter, and Traube has shown that the effect of this is to increase the length of the lung, or its vertical measurement. Consequently as the lung on the healthy side extends lower than in the normal state, the convexity of the diaphragm on this side is diminished, as well as on the affected side, where it is depressed by the effusion.

The pleura in protracted cases of empyema becomes much infiltrated, and from the growth of connective tissue which blends with it, is thickened, sometimes to the extent of one or two lines. A few months since, in removing the lungs from the body of a young infant that perished of empyema in the N. Y. Foundling Asylum, a portion of the costal pleura, two or three inches in diameter, being adherent to the lungs, was detached from the ribs. It had a thickness of fully two lines, and its free surface was rough.

Occasionally the inflammation extends from the pleura to the pericardium, producing general pericarditis. I recall to mind four cases with this complication, in which the diagnosis was verified by post-mortem examinations. All had empyema, three on the left, and one on the right side. Pericarditis, always a grave disease, is almost necessarily fatal when thus occurring as a complication of empyema. More rarely the inflammation extends from the pleura to the peritoneum. One such case occurred in my practice, the child dying of empyema on the right side, and at the autopsy we found the lesions of a localized diaphragmatic peritonitis of the right side, with a fibrinous exudation of small extent on the convex surface of the liver, directly opposite to that on the diaphragm. We are indebted to Von Recklinghausen for knowledge of the mode in which inflammation is propagated from the pleura

to the peritoneum, and the same explanation probably applies to its propagation to the pericardium. In the serous covering of the diaphragm, pleural and peritoneal, minute stomata have been discovered, which pertain to the lymphatic system. They open upon the surface of the diaphragm, and underneath in the substance of the diaphragm connect with lacunæ or interspaces, from which the minute lymphatic vessels originate. These stomata and lymphatic spaces, pervious in their normal state, are usually clogged, as has been stated above, by inflammatory products, when the serous membrane is inflamed. Occasionally the inflammation traverses these lymphatic channels from one surface to the other, from the pleura to the peritoneum, thus causing by extension a circumscribed peritonitis.

The changes which the inflammatory products undergo are the following: With the abatement of the inflammation, the liquid portion begins to be absorbed, though absorption is much more tardy than in non-inflammatory effusions, since the absorbents are to a great extent covered, and clogged by fibrin and pus. The serum is first absorbed, and the flocculi of fibrin sink into depending portions of the cavity, or become attached to the fibrinous layers or the granulations upon the pleural surface. The pus-cells and the fibrin, whether in flocculi or layers, begin to undergo retrogressive change. They become granular from fatty degeneration, liquefy, and are absorbed. Sometimes portions of these degenerated products, which are not absorbed, form inert caseous masses, in recesses of the cavity, or between the bands of connective tissue, where they remain unchanged for years. With few exceptions, those who recover from an attack of pleuritis experience no subsequent ill-effect, though the bands and patches of connective tissue are permanent.

Pus always possesses irritating properties. Decomposed and putrid pus (ichor) is very irritating. Empyemic pus, therefore, like pus in other situations, now and then produces ulceration or necrosis of the pleural surface by which it is confined, and in consequence of its destructive action it sometimes establishes an outlet by which it escapes, with relief of the patient and cure of the disease. The chest wall is thinnest anteriorly, in the inframammary region, and at this point the pus, when it makes its way through the thoracic wall, usually points and discharges. The fistulous opening thus produced continues many months, until the pleural cavity is gradually obliterated by the adhesions, and the patient recovers.

By a similar destructive process in the pulmonary pleura, pus occasionally escapes into the bronchioles, and is expectorated. This mode of cure appears to be common in children, for my attention has not infrequently been called to the fact that children, during the progressive but slow convalescence from empyema, expectorated large quantities of muco-pus, although in some of the cases pus had been removed by the aspirator or trocar. Fraentzel makes the remark, which is fully sustained by clinical experience in this country, that although an opening is made in the lung by the necrotic or ulcerative process, so that pus escapes into the bronchioles, air does not pass from them into the pleural

cavity. Pyopneumothorax is very rare in the empyema of children, except as air is admitted in the operation of thoracentesis.

As the liquid is absorbed, the compressed lung ordinarily expands in proportion to the absorption, so that more and more air enters its alveoli. But frequently, in cases of long duration, the absorption proceeds faster than the expansion, so that the ribs on the affected side sink below their normal level. As a consequence, the intercostal spaces are narrowed, the shoulder is depressed, and the dorsal portion of the spinal column bends to accommodate the ribs so as to be concave toward the affected side. It is very rarely that the deformity thus produced is permanent. Though the newly formed bands and patches of connective tissue may so bind the lung that its return to the normal state is tardy, yet, with few exceptions, the alveoli one after another open to admit air, and when full inflation is attained the symmetry of the chest is restored. But there are rare cases in which the newly formed connective tissue is firm and unyielding almost as cartilage, and lime salts are sometimes deposited in it, forming a calcareous *plaque*, which invests the lung like a cuirass. An unexpanded lung, with such a covering, obviously can never afterward be fully inflated. I can recall to mind, however, only one case of permanent complete collapse or carnification of lung, resulting from pleurisy. The inflammation, which was treated by the late Dr. Cammann, occurred in childhood, and several years afterward, when the patient reached womanhood, although the general health was good, there were physical signs of an unaërated lung, and the consequent deformity (depressed shoulder and ribs, and bent spinal column). Pleurisy with its granulations and retrogressive products affords one of the conditions in which tubercles are developed, so that we sometimes find at the post-mortem examination of cases which have been protracted, "miliary tubercles in the pleura, while chronic phthisis and general tuberculosis are absent" (Delafield).

From the intimate relation of the heart to the lungs, this organ obviously suffers severely in every large pleuritic exudation. Total compression of a lung arrests one-half of the circulation through the pulmonary artery, except as the increased flow in the opposite lung serves for compensation. Hence, in cases of large effusion, which end fatally, we commonly find the pulmonary artery and the right cavities of the heart distended with blood and clots, while the left cavities, having received a diminished quantity of blood, are probably empty.

Symptoms.—As has been stated above, pleuritis in children is sometimes latent, or attended by symptoms so mild as to attract little attention, even when there has been general inflammation of the pleural surface with much effusion. Both primary and secondary pleuritis may present this form, latency being more frequent the younger the patient. In feeble, cachectic children, with blood thin and impoverished, pleuritic symptoms, as pain, dyspnœa, and fever, are less pronounced than in the robust, and, hence, latency is more common in the tenement-house population of the cities and in institutions than in the better walks of life. The following is a not infrequent example of latency. A feeble infant, aged five months and twenty-eight days, died suddenly in the Nursery and Child's Hospital, in December, 1870. The attention

of the resident physician had not been called to it, as it was not supposed to be sick, except that it was ill-nourished and its general condition bad. The nurse who had charge of the ward stated that it presented no symptom of acute disease, unless a slight cough during the three or four days preceding its death. Percussion over the right side of the chest of the corpse gave a flat resonance, and at the autopsy the right lung was found compressed, nearly or quite destitute of air, and covered by a loose fibrinous layer, three-fourths of an inch thick in places, and a moderate serous exudation.

Ordinarily acute idiopathic pleuritis in children begins quite abruptly, and with symptoms which attract attention from the first. Probably in most instances it is preceded by rigors, or a chilly sensation, but this usually escapes notice, if it be present, in patients under the age of five or six years. Fever, fretfulness, and a physiognomy indicative of pain are the common initial symptoms. If the patient be an infant, the fretfulness closely resembles that produced by colic, for which I have on several occasions known it to be mistaken by the attending physicians.

The symptoms of pleuritis are twofold, namely, the constitutional, or such as are common to all inflammations, and the local, or those referable to the chest. Various observers have noted the position in which patients lie in bed, as indicating the seat of the inflammation. It has been stated that adults, in the commencement of pleuritis, ordinarily obtain most relief with a decubitus on the sound side, but when effusion has occurred they lie on the affected side, unless there be marked dyspnœa, which is most relieved by a semierect position, which allows greater descent of the diaphragm. I have not noticed that children with pleuritis prefer any fixed or uniform position, except there be marked dyspnœa, which may prompt them to elevate the shoulders. The patient in the acute stage is commonly quiet when he lies in the position which he selects, and if disturbed from it becomes more fretful, his cough more frequent, and his suffering apparently increased.

In ordinary cases, the temperature rises on the first day to 102° or 103°. If it be more elevated than this, there is usually a complication. The fever begins to abate when the exudation has occurred. In suppurative pleuritis, the febrile movement is more protracted, often continuing for weeks or months, presenting, after the acute stage has passed, the characters of hectic fever with morning abatement and evening recrudescence. In weakly and anæmic children, even when the pleuritis is pretty severe, and most of the usual symptoms are present, the temperature may be but slightly elevated. Thus, in one of the institutions with which I am connected, a young infant, whose fretfulness was during the first twenty-four hours ascribed to colic, the axillary temperature during the first three days never rose above 100°.

The pulse in the acute stage is usually between 100 and 130 per minute, but in young children who are restless it is often more frequent than this during the first week. It is accelerated as long as the temperature is elevated, but in sero-fibrinous pleuritis, after exudation has occurred, its frequency diminishes unless the heart be compressed. Compression and imperfect or partial filling of the cavities of the heart pro-

duce a feeble and rapid pulse. In empyema the pulse is accelerated as long as pus is confined in the pleural cavity, unless its quantity be small.

Headache, usually frontal, is frequent during the febrile stage. Convulsions, which occasionally occur in the beginning of pneumonitis, are rare. Pain in the chest, on the affected side, is common, and is, therefore, a valuable diagnostic symptom, but it is often so slight as to be overlooked in infants and feeble children. It is increased by movements of the chest-walls, as in full inspiration, by coughing, and when pressure is made by the fingers in the examination. Its common seat is between the fifth and eighth ribs, external to the linea mammalis, but there are many cases in which the pain is referred to some other part, as the infraclavicular, mammary, inframammary, or even the scapular or infrascapular region. Rarely, it is referred to the epigastric or umbilical region, or even, it is said, to some point upon the sound side of the thorax. This location of the pain at a point distant from the seat of the inflammation is attributable to the anastomosis of the intercostal nerves with those of the opposite side of the chest, or with those which ramify in the abdominal walls.

The pain of pleuritis, as it ordinarily occurs, has received different explanations. It has been attributed to tension of the pleura, to friction of the pleural surfaces on each other, and to extension of the inflammation to the neurilemma of the minute nervous branches of the pleura. All these causes apparently act in producing it, but the persistent pain in the first days of pleuritis, though increased by motion, is probably due in great part to that last mentioned. Pleuritic pain is sharp or stitch-like. It begins to abate in a few days, and in a large proportion of cases ceases by the fifth or sixth day, or is no longer noticed except in coughing or during sudden movement of the chest.

The respiration is accelerated, as in all febrile diseases, but it is more rapid than in inflammatory ailments which do not involve the thoracic organs, on account of the pain experienced on full inspiration. The patient instinctively avoids full inflation of the lungs, and the breathing is consequently rapid, to compensate for incompleteness of the inspiratory act.

In ordinary attacks of pleuritis, painful and hurried respiration is of short duration. It becomes easier and more natural toward the close of the first week. In subacute and chronic cases, the rhythm and frequency of respiration differ but little from the normal.

A cough, whatever the form of pleuritis, is one of the earliest symptoms. It is short, frequent, and dry, and in the most favorable cases begins to diminish in the second week. A loose cough is due to accompanying bronchitis, or broncho-pneumonitis, or, at a late stage of the disease, to escape of pus from the pleural cavity into the bronchial tubes.

Little need be said in regard to symptoms referable to the digestive apparatus. Vomiting is common on the first and second days. Thirst, loss of appetite, and consequent loss of flesh and strength, are uniformly present. In empyema, which, from its nature, is protracted, nutrition is always greatly impaired. The surface presents an anæmic appearance, the flesh is soft and flabby, and the emaciation is progressive till the pus is evacuated.

Physical Signs.—In children above the age of three or four years, the physical signs differ but little from those in adult cases, but under this age there are certain differences which the practitioner should know. We may, in the commencement of the attack, notice diminution in the movement of the chest-walls on the affected side, since the patient instinctively endeavors to repress respiration on that side, in order to lessen the pain. In severe cases, the epigastrium and hypochondria are sometimes depressed during inspiration (the so-called abdominal respiration), but this sign is less common and less marked than in severe bronchitis, and when present it may be largely due to accompanying bronchitis. After effusion has occurred, and the pain has abated or is slight, the respiration is less accelerated than at first, and it may be nearly or quite normal.

Inequality of the two sides produced by the liquid is more common in children of an advanced age than in those under the age of three or four years. In infants, even when there is a large liquid exudation, the bulging is often so slight that it is scarcely appreciable, either by sight or measurement, and in not a few there is no apparent difference in the circumference of the healthy and affected sides. I have made measurements in infantile pleuritis during the stage of effusion, and been unable to convince myself that there was any difference, although other signs indicated the presence of an effusion which filled at least one-half the pleural cavity. I explain this fact in this way. The lungs of an infant, especially of one reduced by sickness, are very liable to a state of semi-collapse or partial inflation in their whole extent, and of complete collapse of their thin borders, as of the tongue-like process of the left upper lobe, which lies over the pericardium and of the margins of the lower lobes, which lie on the angle made by the thorax or diaphragm. This occurs in the weakly infant, even when there is no obstruction to the entrance of air, and the liability to it is greatly increased by external pressure applied to the lung, as from a pleuritic effusion, so that the lung recedes, becomes compressed, and unaërated, before the ribs yield to the pressure. If the exudation cease as soon as the lung is collapsed, there is little or no outward displacement of the ribs, and the intercostal spaces are not elevated. It is obviously very important to know this difference between infantile and adult cases, as it has a bearing upon the diagnosis between pleuritis with effusion and pneumonitis.

Palpation.—In adults, and in children with strong voices, if the lung, deprived of air either by compression or an exudation within its alveoli, lie against the chest-wall, speaking or moaning produces a vibratory sensation which is communicated to the hand placed upon the chest. The fremitus is feeble or not appreciable when the voice is feeble. Therefore, in infants whose vocal cords are small, and particularly in infants reduced by sickness, this sign is ordinarily absent, or so slight that it is detected with difficulty, while in older and robust children it is distinctly perceived. If the condition be otherwise favorable for the production of fremitus, but the lung be pressed away from the ribs by an intervening liquid, no vibration is felt when the patient speaks or cries. But if, in the same case, the fingers be removed to the suprascapular, axillary, infraclavicular, or mammary region, where the

compressed lung comes in contact with the walls of the chest, fremitus may be perceived. Palpation also enables us to ascertain the point of apex-beat of the heart, variation of which from the normal site being one of the most conclusive proofs of a pleuritic effusion.

Percussion.—In the first hours of pleuritis, there is either no perceptible change in the percussion sound, or the resonance is slightly diminished, from the fact that inspiration on the affected side is resisted by the patient, and the lung is only partially inflated. When exudation occurs, if there be a thin layer of liquid over the lung, the percussion sound is tympanitic. It has, therefore, this quality at an early stage in the inframammary, mammary, and perhaps infrascapular regions, when the amount of liquid is small, and at a later stage, when the quantity of liquid is greater, the percussion sound over the lower part of the chest is dull, while that over the central or upper part is tympanitic. Entire filling of the pleural cavity with liquid, and total exclusion of air from the lung, give rise to a dull or flat percussion sound over every part, from the apex to the base. It may be stated as a rule in the pleuritis of children that, at a certain stage of the effusion, percussion produces a sound which is either decidedly tympanitic or which partakes of the tympanitic character. Skoda attributed the occurrence of tympanism to the fact that a lung still aërated vibrates better if surrounded by a thin layer of liquid, and consequently gives better resonance than when it lies against the chest-walls.

When the exudation is so great that the lung is totally compressed, and removed to a distance from the chest-walls, the finger in percussing experiences a sensation of solidity or resistance, and there is no longer any vibration of the ribs. Consequently the percussion sound is dull or flat, as over any solid body, differing from that in pneumonitis, in which there is still some vibration of the chest-walls, and the dulness is not absolute. In pleuritis, therefore, there is, according to the amount of exudation, either nearly the normal percussion sound, as at the beginning of the attack and in any stage of plastic pleurisy (pleurésie séche), or a zone of dull sound below, and another of tympanitic sound above, or a zone of normal resonance above, and one of dull resonance at the base, with an intervening one of tympanism, or, finally, there is absolute dulness from the clavicle to the base of the chest.

It very rarely happens in the child that the level of the fluid changes by changing the position, on account of the adhesions, so that this sign, described in the books as one of great importance in diagnosis, affords very little assistance to diagnosis in children.

Auscultation.—In the beginning of pleuritis, auscultation affords but slight information, except that the practised ear may detect a little diminution in the fulness of the respiratory act in the lung, whose pleura is inflamed, and perhaps a slightly exaggerated respiration in the other lung. But after twelve or fifteen hours, when exudation begins to occur upon the pleural surface, we may hear the dry friction sound, which can be imitated by pushing the finger strongly across the dry palm of the hand. It is only heard in occasional cases, since the physician may not make his visit at the proper time for hearing it, or he does not apply the ear over the proper place. Fraentzel says:

"We shall scarcely ever fail to find the friction sound, in recent pleuritis, if we look for it early and diligently in some circumscribed spot." I do not think that this remark, however true it may be of adult cases, is entirely correct as regards children, for it is only in exceptional instances that it can be heard in them. It occurs both during inspiration and expiration, and it does not disappear after coughing. Being produced upon the surface of the lung, it seems near the ear of the auscultator. Perhaps it is not observed during several consecutive respirations, and then a deeper inspiration causes the pleural surfaces to glide upon each other, and it is detected. The friction sound as sometimes heard is well expressed by the term scraping, and in other cases by the term creaking, as was noticed by Hippocrates, who compared it to the creaking of leather.

In some patients it is heard for a brief period and does not recur, and it may be detected only during strong and deep respiration or in coughing. It disappears entirely when the accumulation of liquid prevents contact of the surfaces. After absorption of the liquid, the friction sound may reappear, and in certain patients it is heard only at this time, to wit, in the third stage.

An interesting and common sound heard on inspiration is the so-called *crepitant râle of pleurisy*, produced in the superficial alveoli. The remarks made by Trousseau upon it have been already given. As stated above, the inflammation extends from the pleura to the pulmonary vesicles which lie directly underneath, and as soon as exudation occurs within them, the anatomical conditions are present in which the crepitant râle is produced, as in the ordinary form of pneumonitis. This râle may obviously be heard before any effusion takes place upon the free surface of the pleura, and it continues until the alveoli are so compressed by the pleuritic exudation that they no longer admit air.

The exudation in the pleural cavity changes the character of the respiratory sound. A thin layer of liquid over the lung causes diminution in the force of the vesicular murmur, and soon an expiratory as well as an inspiratory sound begins to be heard. This modified vesicular murmur is weak, and more distant from the ear than the respiratory sound of health. When the exudation is sufficient to close the alveoli, while the air still traverses the medium-sized bronchial tubes, we notice a tubular or bronchial *bruit*. If the small and medium-sized tubes are compressed, while the air enters the large tubes, the respiratory bruit may be amphoric. Total absence of respiratory sound results from complete collapse of the alveoli, and consequent exclusion of air from them, and arrest of the movements of the air in the tubes of the affected side. Jaccoud says: "Regarded as a sign of the quantity of the effusion, the modifications of the respiratory *bruit*, and of the respiration, may then be arranged, in an increasing series as follows: diminution of the vesicular murmur; feeble respiration (*souffle doux*); no sound, and feeble respiration; bronchial respiration; no sound, and bronchial respiration; no sound, and cavernous respiration; general absence of sound (*silence général*). The replacement of an inferior term of the series by a superior term implies an augmentation in the quantity of liquid, and in general the passage of a superior term to an inferior term

denotes a diminution of the effusion." But this statement relating to the effect upon the auscultatory sounds of the increase and decrease of the liquid must be modified as regards patients under the age of five years. In such patients it is rare, however great the effusion, that respiration is not heard when the ear is placed over the liquid. This is due to the small size of the pleural cavity, and the consequent ready transmission of sound from the centre of the thorax to its periphery. According to the amount of exudation and the degree of compression, the respiratory sound is a faint and distant vesicular, or broncho-vesicular, or bronchial murmur, and its character is found to vary from one to the other of these sounds, as we apply the ear over different parts of the chest.

When the inflammation is active, and the exudation occurs rapidly, bronchial respiration may be heard as early as the second or third day, or even by the close of the first day, in the infrascapular region. If, on the other hand, the inflammation be chiefly plastic, or the exudation of liquid be slow, and its quantity small, the respiratory murmur may be vesicular, though faint and distant, during the whole course of the attack. Sometimes when the murmur is vesicular in the greater part of the lung, broncho-vesicular or bronchial respiration is heard over a limited area, where the effusion happens to be sufficient to produce requisite compression of the lung.

The voice of the patient, when auscultated over the affected side, has a character which corresponds with and varies according to the respiratory murmur. Vocal resonance is feeble or absent if the respiratory murmur be vesicular. If it be bronchial, the auscultated voice is more distinct, having the character known as bronchophony, or when there is a moderate quantity of liquid over the lung, so that this organ vibrates, it may have that modification of bronchophony known as ægophony. Occasionally we can hear the voice as a confused and distant sound, when the quantity of liquid is so great that respiration is inaudible. The signs derived from the auscultated voice are not, as is well known, pathognomonic of liquid effusion. Bronchophony is more common and distinct in pneumonic or tubercular solidification of lung than in pleuritis, and even ægophony may be produced without the presence of a liquid, by "pleural membranes realizing certain physical conditions" (Jaccoud). But since the auscultated voice is weaker in children than in adults, we often do not hear it in infants and ill-conditioned children, even when the anatomical conditions, as regards the lungs and pleural cavity, are favorable for its transmission.

In children as in adults, bronchial râles are common in pleuritis, dry or moist; coarse when produced in the larger tubes, or fine when occurring in the finer tubes.

Diagnosis.—Ordinarily, a careful observance of the history, symptoms, and physical signs enable the physician to make a positive diagnosis. Obscure or doubtful cases occur chiefly in infancy. Circumscribed pleuritis, or pleuritis attended with little or no liquid exudation, is obviously likely to be overlooked, and its symptoms mistaken for another disease.

Pleuritis, before the stage of exudation, may be mistaken for pneu-

monitis, since the prominent symptoms in the commencement of the two diseases are similar. But in pleuritis there are commonly greater acceleration of pulse and respiration, greater suffering, as evinced by the features, greater tenderness on percussion, or on pressing the chest-wall, and a more decided expiratory moan, while the patient probably endeavors to repress respiration on the affected side, so that inflation of the lungs is partial and shallow. It will aid in the diagnosis to recollect that, in children under the age of five years, acute pneumonitis is, in most instances, catarrhal, and not croupous, and is preceded and accompanied by severe bronchitis, being due to downward extension of the inflammation from the bronchial tubes. It therefore does not begin with the abruptness of pleuritis.

Pleuritis with effusion may be mistaken for pneumonitis in the stage of solidification, for hydrothorax, or, on the left side, for pericardial effusion, or *vice versâ*. But the percussion sound over a pleuritic exudation is either tympanitic or flat, while over a lung solidified by inflammation it has some resonance, though dull. There is also a sensation of greater resistance and solidity in percussing over a pleuritic exudation than over an inflamed lung. Moreover, the respiratory murmur, whether vesicular, broncho-vesicular, or bronchial, is more distant and less distinct to the ear of the auscultator when applied over a liquid than over a solidified lung.

A pleuritic exudation, unless slight, also changes the apex-beat of the heart, pressing it toward the median line in left pleuritis, and away from the median line in right pleuritis, as has been stated above—a change not observed in pneumonitis. Bulging of the intercostal spaces, expansion of the chest-walls, change in the height of the fluid by change in the position of the child, important signs in the diagnosis of adult pleuritis are, as we have seen, commonly absent in young children, even when there is abundant liquid effusion, but they are sometimes observed in children of a more advanced age. Bronchophony and vocal fremitus, signs of pneumonic solidification, are absent, or so feeble in the pneumonitis of young children that their absence cannot be regarded as indicative of the presence of pleuritic effusion, except in children over the age of four or five years. Moreover, these signs, when present, do not necessarily indicate pneumonitis, for if, in pleuritic effusion, the ear or hand be placed over a part of the chest where adhesions have united the lung to the ribs, and the child be of such an age that the vocal cords have sufficient vibration, both bronchophony and the fremitus may be perceived. The absence or presence, therefore, of vocal fremitus and bronchophony affords only limited assistance in the differential diagnosis of pleuritis and pneumonitis in young children. In those of an advanced age whose vocal cords have greater vibration it aids in the discrimination of doubtful cases, especially if the examination be made in the infrascapular region, which corresponds with the location of the liquid, if any be present.

A pleuritic effusion is distinguished from hydrothorax by the fact that the latter is usually bilateral and of slow increase, without symptoms referable to the chest, except when there is considerable effusion, which causes more or less dyspnœa. Pleuritis, unlike hydrothorax,

causes fever and otner constitutional symptoms, and also a cough, pain in the chest, and early embarrassment of respiration. Moreover, hydrothorax seldom occurs, except from cardiac or renal disease, or scarlet fever.

A greatly distended pericardial sac simulates, in some degree, a pleuritic effusion on the left side, but the absence of symptoms which pertain to pleuritis, as the cough, stitch-like pain in the chest, the localization or greater distinctness of the dull sound on percussion, in the cardiac region, absence or feebleness of the apex-beat, and indistinctness or distance of the heart sounds, will preserve the observant physician from error of diagnosis.

Prognosis.—In mild cases attended with little exudation, the inflammation soon begins to abate, and, by the close of the second week, the symptoms have nearly disappeared. In plastic and sero-fibrinous pleurises, recovery may be confidently expected, unless there be some grave complication, or perchance syncope should occur from large and rapid effusion. A large effusion, whatever its character, especially if located on the left side, often causes such a twist in the great vessels within the thorax as seriously to retard the circulation of blood and endanger life. In effusions of the left side, the heart is often carried so far toward the right that the ascending vena cava, where it emerges from the central tendon of the diaphragm, is bent at an angle so as seriously to obstruct the return of blood from the lower half of the body, and consequently a reduced quantity of blood reaches the right cavities and the pulmonary artery. The result is a diminished flow of blood in the systemic circulation, with anæmia of important organs, as the brain. The great arteries connected with the heart are also more or less bent in cases attended by displacement of this organ. In effusions on the right side, the right auricle and ventricle sometimes do not expand to the normal extent during the diastole, on account of the pressure of the liquid, and the result is similar to that in effusions on the left side, as regards obstructed circulation and anæmia of important organs. Therefore, patients with large pleuritic effusions, whether left or right, are liable to sudden fainting and even to fatal syncope. Fortunately, with our present improved methods of thoracentesis, children need not perish in this way if the operation be resorted to at the proper moment. There is another danger. When, in consequence of the exudation, the lung is so compressed that its function is nearly or quite lost, the sound lung obviously receives an augmented supply of blood. It is, therefore, very liable to sudden congestions and transudation of serum (œdema). If this occur, the dyspnœa is augmented and the condition is one of utmost peril. Death may result from this state.

The prognosis obviously varies according to the cause of the inflammation and the quantity and nature of the exudation. Idiopathic pleurisies do better as a rule than those which occur as a complication or sequel of some other disease. Absorption is more rapid in the beginning of convalescence, when the fluid is thin, than at a later period, when it has greater consistence. Fibrin, whether flocculent or laminated, is necessarily slowly absorbed, first undergoing fatty degeneration and liquefaction. Empyema, if not relieved by operative measures,

continues many months, and even after pus is let out convalescence is slow. In the very considerable number of empyemic cases which have from time to time been brought to the class of children's diseases in the Bureau for the Relief of the Outdoor Poor, the histories commonly showed that the disease had continued from three to six months, with progressive loss of flesh and strength. Nevertheless, after proper evacuation of the pus and establishment of a fistulous opening, the majority have gradually recovered, death in the unfavorable cases being commonly due to extreme prostration with perhaps fatal organic changes, as amyloid degeneration and tuberculosis.

Secondary pleuritis occurring in a reduced state of the system, as after scarlet fever, and pleuritis complicated by a grave disease, as pericarditis or pneumonia, are always dangerous to life.

It is the common belief that pleuritic effusions involve greater danger on the left than on the right side, from the fact that the former produces more immediate and direct pressure on the heart and causes a greater twist in the vessels, but Leichtenstern[1] states that, in 52 cases of sudden death from pleuritic effusions, 31 were right and 20 left pleurises. The walls of the right cavities of the heart, upon which the liquid in the right pleural cavity directly presses, are thinner and therefore more yielding than the walls of the left cavities. The records of the cases collected by Leichtenstern show that sudden death sometimes results from extensive and far-reaching thrombi in the right cavities of the heart and in the superior vena cava, or to emboli detached from the thrombi and intercepted in the pulmonary artery. In grave cases attended by large effusion, sudden death sometimes occurs after some exertion on the part of the patient, as after vomiting, severe coughing, or hurried rising to the erect position, or lifting a heavy weight. It is believed that, under such circumstances, there is a retarded flow of blood through the lungs and into the left cavities of the heart and the aorta, so that sudden and fatal anæmia of the brain is produced.

As already stated, death may occur in protracted cases from amyloid degeneration of important organs, as the kidneys and liver. This can sometimes be detected by enlargement of liver and spleen, and the occurrence of albuminuria.

It is evident that the prognosis varies greatly according to the degree of dyscrasia. In profound blood-poisoning, whether scarlatinous, uræmic, or septicæmic, pleuritis is always grave. Septic pleuritis, which occurs for the most part in newborn infants, during epidemics of puerperal fever is especially so. When it has continued a few hours, the pinched features and rapid sinking show that we have to deal with something more than an ordinary attack.[2]

Pleuritis is also very severe, and ordinarily fatal, when it is caused by the entrance of some pathological product into the pleural cavity, as pus or decaying lung substance.

[1] Deutsches Archiv für Klin. Med., Band iv.

[2] The following case, which occurred in my practice during the recent epidemic of puerperal fever (1881), may be adduced as an example: Mrs. D., a primipara, was delivered by the forceps after a tedious labor, at 9 P. M., April 6th. On the following morning her temperature, without the occurrence of a chill, had risen to

TREATMENT.—It will be convenient, in considering the treatment, to describe that which is appropriate for each of the three stages into which systematic writers have divided pleuritis: First, the stage preceding effusion; secondly, that of effusion; and thirdly, that of absorption and convalescence. In the beginning of the inflammation, appropriate measures should be promptly employed for the purpose of reducing the inflammation, and preventing or diminishing, so far as possible, the exudation that soon follows. The abstraction of blood is now properly discarded in the treatment of most inflammations of infancy and childhood, but in certain cases of pleuritis occurring in robust children over the age of four or five, or even three years, the early and judicious employment of one or two leeches diminishes the pain and apparently also for a time the febrile movement and the inflammation. But it may be stated as a rule that the loss of blood is not only not required, but is injurious in all secondary pleurisies, and in the primary form after exudation has occurred. It is injurious in all forms of pleuritis in pallid and cachectic children, and, therefore, in a large proportion of the cases occurring in the tenement-houses and institutions of the cities. The flow

105½°, and her pulse varied between 125 and 134. She was in a critical state for several days, with a temperature varying between 103° and 105½°, and without any local symptoms either of metritis or cellulitis, but finally recovered. The baby, healthy and vigorous at birth, had been allowed to obtain what nutriment it could from the breast, but the nurse remarked that she "never saw a child sleep so much," and I gave very little attention to it, as my time was devoted wholly to the mother. On the 10th, when four days old, its sleepiness ceased, and it became constantly fretful, as from colic, and it refused to draw upon the nipple. Early in the morning of the 11th I was summoned to it, and was astonished at its altered appearance, its shrunken features, and its evidently dying state. Percussion upon the right side gave a flat resonance from the clavicle to the diaphragm, and there was some meteorism in the abdomen. The thermometer introduced into the rectum showed no elevation of temperature, and no unusual heat of surface or cough had been noticed by the nurse. By active stimulation the infant lived till the middle of the afternoon. The autopsy revealed a sero-fibrinous exudation filling the right pleural cavity, producing complete carnification of the lung, so that it resembled that of the fœtal state, and soft patches or flakes of fibrin upon the lungs. By an oversight, the peritoneum was not examined. Cases like this, of pleuritis in the newborn, produced, it is thought, by the wandering micrococci of the septic state, occur chiefly during epidemics of childbed fever. Some years ago I saw a newborn infant in one of the institutions, whose mother had puerperal fever, die in a similar manner, and the autopsy showed that the cause was peritonitis. The following extracts from Trousseau's clinical lecture on erysipelas of newborn infants will aid in understanding such cases. Speaking of Dr. P. Lorain, he says: "During the epidemic at the maternity, where this able and laborious observer was a resident pupil, he collected the information of which the following is a summary: Of 106 stillborn infants, 10 were found to have died from peritonitis, and 3 of the mothers of these 10 infants were carried off by puerperal fever after delivery. Of 193 infants born alive, 50 died of the very same affections which proved fatal to the lying-in women. The most frequent causes of death were peritonitis, numerous abscesses, purulent infection, phlegmonous swellings, erysipelas, gangrene of the limbs, putrid infection, or some other remarkable septic condition." . . . "Mother and child then are subject to the same morbific influence." Further on, Trousseau says of the infant affected by this puerperal poison: "He will cry incessantly from pain. A state of restlessness will be succeeded by collapse, which will close the scene on the fifth, sixth, or seventh day. On examining the body after death, pus will be found in the cellular tissue, sometimes *suppurative pleurisy*, more frequently phlebitis of the umbilical vein, or of the vena porta, or peritonitis." An interesting incidental fact shown by these statistics is that the cause of this puerperal disease of the newborn is sometimes operative in the fœtal state.

of blood from the bites if leeches are employed should ordinarily be arrested after two or three hours, but if slight it may continue longer in vigorous children of eight or ten years.

At the first visit of the physician, an emollient and slightly irritating poultice should be ordered, enveloping the entire chest, to be constantly worn, except as it is temporarily removed during the application of the leech, and the subsequent flow of blood. The poultice should be so mildly irritating that it causes constant redness of the skin without pain, and it should not be removed except when a fresh poultice is prepared to replace it. Thus employed it produces constant dilatation of the capillaries of the skin, and, by the fluxion caused, diminishes the engorgement of the capillaries of the costal pleura. A poultice of common mustard, with flaxseed in powder, one part to sixteen, between two pieces of muslin, and so wet that it moistens the hand in holding it, produces this effect. Applied morning and evening, it can be constantly worn without complaint of pain produced by its irritating action. For infants under the age of eight months, I prefer the use of plain flaxseed, with camphorated oil smeared upon its under surface. The oil may be applied several times daily, while the morning and evening application of the poultice is sufficient. Spongiopilin or compresses of flannel wrung out of hot water and covered with oil-silk meet the indication, and possess the advantage of being lighter and cleaner, and more readily applied than the poultice. Redness may be produced by applying under the spongiopilin a single thickness of muslin soaked with camphorated oil, or for children of a more advanced age, with camphorated oil and one-fourth part of turpentine.

Vesication, formerly much employed, has properly nearly fallen into disuse in the treatment of the pleuritis of children. While it is liable to increase the suffering, it has apparently no tendency to diminish the inflammation, in whichever stage employed, and there is no certainty that it stimulates the absorbents and expedites the removal of the liquid, according to the old theory. A case is reported, in the practice of one of the New York physicians, in which a blister had been applied when the inflammation was still active, and at the autopsy the portion of the costal pleura which lay directly underneath the surface that had been vesicated was covered by a thicker fibrinous exudation than that upon the contiguous surface. The increased afflux of blood caused by the blister had, to appearance, extended to the costal pleura, and increased the pleuritis. The application of cold bandages around the chest, which is recommended by some, seems to aggravate the cough in certain patients, and does not ordinarily give the relief of moist and warm applications.

Internal Remedies.—The indications are to employ such medicines as diminish the frequent action of the heart, and thus retard, in a measure, the flow of blood to the pleura, and such as diminish the pain and frequency of the cough, which, by increasing the friction of the pleural surfaces, tends to increase the inflammation. For robust children over the age of three years in the first stage of primary pleuritis, the tincture of aconite may be prescribed, half a drop for a patient of three years, and one drop for one of six years, every third hour for two or three

days, or until the required effect be produced upon the pulse, when it should be discontinued. It is, as a rule, too depressing for younger patients. Digitalis is a better and safer remedy for children under the age of three years, for all secondary pleurisies, and for all cachectic cases. Benefit results from continuing the use of digitalis in the stage of exudation when aconite would be inadmissible. A child of two years can take two drops of the officinal tincture, and one of five years four drops every two or three hours.

Antipyrin is the most effectual antipyretic which we possess. One or two doses reduce temperature two or three degrees. It therefore promises to be a useful remedy in the first stage of pleuritis as well as in other acute diseases, when the temperature is so high as to involve danger. It is not a tonic, and it seems to impair the digestive function. It is, therefore, most useful in those diseases which are not attended by any marked prostration, but in which the fever, from its intensity, exhausts the strength. If, therefore, in the commencement of pleuritis the temperature rises above 103°, it may properly be prescribed in doses of four grains to a child of five years, and be repeated, if necessary, in three hours. It is soluble in water, and it may be employed as an enema if the stomach be irritable.

The use of quinia is suggested, since it is an antipyretic and tonic, but in my practice it has been much less useful in pleuritis than in pneumonitis. This agent, in whatever form given, does not appear to exert any notable controlling effect either on the fever or gravity of pleuritis. Nevertheless, I have often employed it, especially in secondary pleurisies, with or without digitalis, and it probably does some good as a tonic. The salts of quinia, as ordinarily given in solution to young children, are frequently vomited. When vomited, a soluble salt, as the bisulphate, may be given as a suppository, or Squibb's oleate of quinia may be employed by inunction. I should, however, add that, though I have used inunctions of the oleate in pleuritis during the last year, ten grains of the alkaloid, at a time, I have not seen any marked beneficial effect. To meet the second indication in the treatment of the first stage, namely, to relieve the pain and restlessness, and to diminish the cough, so that there is less friction of the pleural surfaces, our chief reliance must be on hyoscyamus or one of the opiate preparations. The following formulæ will be found useful:

℞.—Tinct. opii deodorat. . . gtt. xx.
Tinct. digitalis . . . . gtt. xl.
Syr. pruni Virginiani . . ℥j.
Aquæ . . . . . ℥jss.—Misce.

Dose, one teaspoonful (one drachm) every three hours for an infant of eighteen months. The tincture of hyoscyamus may be employed in place of the opiate in double the dose.

For a child of three years:

℞.—Tinct. ipecac. comp.
(Squibb's liquid Dover's powder),
Tinct. digitalis, } āā gtt xxxij.
Syr. pruni Virginiani . . ℥ij —Misce.

Dose, one teaspoonful every two or three hours.

For a robust child of eight years with primary pleuritis:

℞.—Morph. sulphat. . . . . gr. j.
Tinc. rad. aconit. . . . . gtt. xx.
Syr. pruni Virginiani . . . . ℥ijss.—Misce.
Dose, one teaspoonful every three hours.

The diet in the first stage should consist of milk and farinaceous food, given liberally. The meat-teas or the expressed juice of meat may be added, and in secondary pleurisies, as after scarlet fever, it is often proper to give a moderate amount of alcoholic stimulants from the first.

Second Stage.—Measures employed in the first stage have been designed to diminish the inflammation and relieve suffering. The duty of the physician, in the treatment of the second stage, is chiefly to aid in the removal of the inflammatory product, and prevent, so far as possible, its further formation. If this be sero-fibrinous, and its quantity be small, so as to fill only the lower portion of the cavity, little aid may be needed from therapeutics; but a larger effusion, compressing the lung and displacing the heart, requires medicinal and often surgical measures. The recommendations of Niemeyer, that the patient's food contain little liquid, and that his drinks be restricted, as a means of increasing absorption from the pleural surface, is not applicable to young children, whose diet must of necessity be largely liquid, and that of infants chiefly milk.

Attempts to stimulate the absorbents by external treatment of the chest are of doubtful efficacy, whether by the application of the so-called small flying-blisters, the iodine ointment or tincture, or a stimulating liniment. The common practice of treating glandular swellings by iodine applications suggests their use for pleuritic effusions, and of the agents employed locally to hasten absorption they are probably the best, but they should not be used so often or in such quantity as to cause pain or restlessness from their irritating effect.

It is an established principle in therapeutics that the removal of a serous liquid in either of the larger cavities of the body is hastened by such remedies as produce an abundant liquid secretion or transudation from any of the organs or surfaces. Hence in the treatment of pleuritic effusions, those medicines which act on the skin causing diaphoresis, upon the intestines causing watery stools, and upon the kidneys causing diuresis, are at once suggested as most likely to be efficacious. But sudorifics, though useful for dropsies having a renal origin, have not been much used of late years for the removal of exudations in the pleural cavity, experience having shown that they are inadequate for this purpose. Recently, however, the discovery of a very active agent of this class, jaborandi, has revived, in a measure, the sudorific treatment of the second stage, so that in the National Dispensatory of Stillé and Maisch this diaphoretic is one of the recommended remedies. But the heart, crippled in its action by the pressure of the liquid, badly tolerates agents of a depressing nature, and jaborandi, or its active principle pilocarpin, exerts a weakening effect on this organ. It therefore should be used with caution in this disease. It is probably best, in most instances, not to employ it, inasmuch as we possess other and efficient remedies.

The fact that sero-fibrinous exudations have been known to diminish rapidly during attacks of diarrhœa suggests the use of purgatives; but, although an open state of the bowels, as two or three daily stools, aids in absorption, free purgation is badly borne by young or feeble children, as it reduces the strength, and, therefore, is not to be recommended as a therapeutic measure. Moreover, there is not the need of employing severe or exhausting medicines for the removal of the liquid, which existed in former times, since we are able to accomplish this quickly, easily, and safely by the excellent aspirating instruments now in common use.

Diuretics, on the other hand, are apparently more useful while they are less exhausting, than sudorifics or cathartics. Digitalis, combined with the citrate or acetate of potassium, has stood the test of experience, and is now more widely used than any other agent of this class. Being both a diuretic and heart tonic, it possesses properties which render it especially serviceable in the treatment of pleuritic effusions. The following is a useful prescription for a child of five years:

℞.—Potassii acetatis . . . . . ʒij.
Infus. digitalis . . . . . ʒiij.—Misce.
Give one teaspoonful every three hours.

It is a matter of observation that absorption occurs more rapidly, and a sero-fibrinous is less likely to become a purulent effusion, if the bodily condition be good. Hence tonics, especially the bitter vegetables, are sometimes useful, and a diuretic in combination with a tonic, as the acetate of potassium in decoction of cinchona, may often be prescribed with advantage.

Still, however judicious the treatment, hygienic and medicinal, many cases require surgical interference, and the number of such is larger in the city than in the country, and in tenement-houses than in the better walks of life, since the cachexia so common in city children increases the liability to purulent exudations.

Thoracentesis.—The indications for the operation are the following:

1st. Dyspnœa due to the presence of the liquid, whether it be sero-fibrinous, purulent, or hemorrhagic. Usually when dyspnœa occurs, the pleural cavity is full, but if there be parenchymatous disease of either lung, a moderate quantity of liquid may cause such embarrassment of respiration that thoracentesis is indicated.

2d. A flat percussion sound over the entire affected side, with displacement of the heart, even if there be no present dyspnœa, is also an indication for the operation, for dyspnœa may occur suddenly with other alarming symptoms between the visits of the physician. Moreover, experience has shown that absorption from a distended pleural cavity is very tardy, in consequence of compression of the absorbents, whereas, if a portion of the liquid be removed, absorption of the remainder is more rapid. The patient with full pleural cavity and lung totally compressed lies on the affected side, and is usually uncomfortable in any other position, and the withdrawal of a portion of the liquid, as, for example, one half, the operation being discontinued when the patient begins to cough or evince distress, produces no ill-effect, and increases the comfort.

3d. A moderate effusion, without material decrease in quantity after some weeks of observation, also indicates the need of surgical interference, since long compression of a lung involves risks. There is danger that catarrhal ending in cheesy pneumonia and tubercles may occur in a lung whose function is long suspended; besides the longer compression has existed, the more tardy, difficult, and incomplete will be the inflation when the liquid is removed, on account of the altered state of the alveoli, and the presence of fibrinous bands over the lung. Thus, in a case recently under observation, only partial inflation of the lung occurred, after letting out the liquid, so that the ribs and shoulder on the affected side are permanently depressed, and unequivocal symptoms of tuberculosis are now present.

4th. If the inflammation extend to the pericardium, so as to cripple the heart's action, or if there be any serious preëxisting heart disease, the liquid, even in moderate quantity, may, by pressure, so embarrass and retard the heart's action that its cavities are not properly filled, so that passive congestion of certain organs, and dangerous anæmia of others, especially of the brain, may result. Under such circumstances, an early performance of thoracentesis is indicated.

5th. *Empyema.*—The presence of pus in the pleural cavity affords in itself, in a large proportion of cases, sufficient indication of the need of thoracentesis. In recent cases, with only moderate constitutional disturbance and embarrassment of respiration, if we ascertain by the hypodermic syringe that the liquid is only slightly clouded by leucocytes, surgical interference may be postponed, while the acute inflammation is treated. Thus, in case of an infant of two months, thin pus was withdrawn on the fourth day of acute pleuritis, and, although thoracentesis was early performed, it appeared probable, from the subsequent course of the case, that it would have been as well had the operation been deferred. If spontaneous evacuations of pus have occurred through one of the intercostal spaces, producing a fistula, from which there is a daily oozing, or if it be probable, from the symptoms and signs, that pus is escaping from the pleural cavity into a bronchial tube, and is being gradually expectorated—a mode of cure which, as I have elsewhere stated, is not infrequent in children—thoracentesis may be deferred. In the case of an infant, aged six months, recently under treatment for empyema of the left side, we removed four ounces of pus, and washed out the pleural cavity. The opening having closed, and the physical signs indicating the reaccumulation of a considerable quantity of liquid, we were preparing for a second operation, when the parents and nurse called our attention to the fact that there were occasional severe attacks of coughing, during which the breath presented a very decidedly purulent odor. Although there was no external expectoration, as the sputum was swallowed, thoracentesis was postponed, and the result justified the decision, for the patient gradually convalesced. Except under circumstances like the above, empyema, when clearly diagnosticated, by the employment of the hypodermic syringe, should be promptly treated by evacuation of the pus.

Instruments to be Used, and Mode of Operating.—Ingenious instruments for tapping the chest have been invented by Dr. Chadbourne, of

the New York Foundling Asylum, Dr. A. M. Phelps, of Chateaugay, Franklin Co., N. Y., and others, which, by India-rubber packing, totally exclude air, while the operation is performed with facility and little pain. That devised by Dr. Chadbourne has a canula with two arms, one for attachment by means of tubing, to the exhausting receiver, and the other is designed to facilitate irrigation of the pleural cavity.

Phelps's apparatus has a third tube, entering the bottle through the stopple, and a glass tube passes from the stopple to nearly the bottom of the bottle. With this apparatus, by reversing the movement of the syringe, the liquid can be withdrawn from the chest, the bottle emptied of it, the water used for irrigation be conveyed into the bottle, from the bottle to the chest, and back into the bottle, without changing the position of the bottle or removing the stopple. I would suggest the use of the trocar and canula instead of the sliding aspirator point which plays outside the canula, as an improvement in this instrument.

The instrument which I have been in the habit of employing is of simpler construction. The canula has about the size of the smallest needle of Dieulafoy's aspirator; the proper size, in my opinion, for thoracentesis, for both sero-fibrinous and purulent exudations. I greatly prefer the use of the exhausting-bottle rather than the exhausting-pump without the bottle, as it is more convenient and produces greater suction, from its greater size. The canula is provided with an arm, which connects it by tubing with the exhausting-bottle. Beyond this arm, the body of the canula, sufficiently expanded to contain India-rubber packing, extends about one and one-half inches, and is provided with a stopcock. Through this packing the trocar is introduced, and, after the puncture, it is withdrawn to the stopcock, which is then turned to prevent the admission of air. Then the obturator is introduced in place of the trocar, so as to remove any obstruction which may enter the canula.

The tubing which extends from the arm of the canula to the bottle should be firm, with a somewhat larger bore than that of the canula, and its point of attachment to the bottle should also be provided with a stopcock. A short glass tube introduced into this tubing near the canula is convenient for noticing the character of the fluid, which, if it be thick pus, may flow with difficulty, and not reach the bottle. A bottle of sufficient capacity to hold two quarts obviously produces more suction power than one of less size, and is, therefore, preferable for certain cases, and its sides should be marked to indicate ounces and drachms. The tube which connects the canula with the bottle enters through the stopple, and proceeding from the stopple is another tube similar to the first, to which the syringe is attached. The syringe has two points for attachment to the tube, and a double action in its interior, so that attached by one point it exhausts the air from the bottle, and attached by the other point it condenses air in the bottle. The stopcock between the canula and the bottle should always be closed when the syringe is used, whether for exhaustion or condensing. It is very important that this should be constantly borne in mind when working the syringe, or air may be thrown into the pleural cavity and much harm done.

Mode of Operating for Sero-fibrinous Exudations.—In the following

remarks I shall state what I consider the best method for performing thoracentesis, having formed my opinion from the cases which I have witnessed and been able to follow, in institutions and in family practice. A mode of treatment which may be safe and proper for the adult is not always the best for the child, and, as there are different opinions and different modes of procedure, and as many who are familiar with adult cases recommend similar treatment for the child to that which they have employed with success for the older and more robust cases, I shall advise the abandonment of certain measures which are in common use, and the substitution of others. The hypodermic syringe should be first introduced at the point where it is proposed to perform the operation, the needle being inserted about one inch, for I hold it unjustifiable to tap the chest without first ascertaining that there are no adhesions at the site selected for puncture, and at the same time ascertaining the character of the liquid. Incision of the skin with the knife and spraying the surface with ether are not required as preliminary treatment, since the puncture is quickly and easily performed with a small trocar, and with very little pain. The rule is established by many observations that the operation should be performed in or near the vertical line passing through the angle of the scapula, and between the eighth or ninth ribs, or one of the adjacent intercostal spaces. I have elsewhere stated that a point a little external to this line is preferable, as the lung is less liable to be injured. The instrument should obviously be inserted no farther than will be sufficient to reach the liquid, and, since from measurements which I have made, the thickness of the thoracic wall in rather fleshy children is about half an inch, penetration to the depth of one inch will ordinarily be sufficient to pass the fibrinous layer. We are liable to puncture more deeply than is necessary without some safeguard, and incur the risk of wounding the lung. India-rubber tubing may cover the instrument to within one inch of the end, or a cord may be tied snugly around the instrument at one inch from the tip. The sensation communicated to the fingers will, however, be the best guide to the careful operator as regards the exact depth to which the instrument should be carried. The trocar should now be withdrawn, the obturator introduced in its place, the air exhausted from the bottle, and then the stopcock turned, to allow the liquid to escape.

It should flow slowly, as it probably will, through so small a canula, but the flow can be regulated by the stopcock. The quantity to be removed depends upon the age and condition of the child, the size of the cavity, and the quantity of the liquid, but if the patient begin to cough or feel uncomfortable after the removal of one-half, or even one-third of the liquid, the canula should be withdrawn. The sensation of insufficient breath is no longer experienced, and the remaining liquid is progressively absorbed. This operation is one of the easiest in surgery, while, with the precautions mentioned above, no ill effect need be apprehended. One operation is, in most instances, all that is required, though, if need be, it can be repeated after some days, and it is very seldom that the lung does not fully expand to fill the chest if the operation be performed at the proper time.

Mode of Operating for Empyema.—It will aid in understanding this

part of our subject to remember that all pleuritic exudations contain pus-cells, and that the only anatomical difference between sero-fibrinous exudations and empyema is in the proportion of these cells. There is, therefore, no fixed and definite boundary line between the two kinds of exudation. The term empyema is, as all know, applied by common usage to the liquid when it contains so many leucocytes or pus-cells that a turbid appearance is imparted to it. Absorption is slow and difficult, or impossible, if the liquid contain a large amount of solid ingredients, to wit, fibrin and pus-cells, while liquid containing only a small proportion of these constituents more readily enters the absorbents. In other words, thin pus may be absorbed and removed from the system by natural methods, or by the same instrument and operation which we have recommended for sero-fibrinous exudations, while a thick liquid adherent to the pleura, or sinking heavily in dependent portions of the cavity, disappears very slowly, losing by absorption only a little of the liquor puris, while the bulk of it cannot be absorbed, so that the only relief is by evacuation through an opening. Often in practice, after the acute symptoms of an empyema have in a measure abated, the physical signs indicate some diminution of the liquid in successive weeks, but further removal soon comes to a standstill, and the resources of surgery must be tried.

The same small trocar and canula, or a little larger, should be used for tapping the chest of an empyemic child which we have recommended for sero-fibrinous exudation, and with the same precautions. If the liquid be thin and but slightly turbid, if it be but little removed from sero-fibrin in its character, it will flow through the canula, even if it be necessary to use the obturator often to remove obstructions. Having withdrawn all the liquid which will flow through the opening, unless severe coughing or some unpleasant symptom occur, which is an indication to discontinue the withdrawal, the instrument is removed, and the aperture may be closed with adhesive plaster. In exceptional instances one operation is sufficient to effect a cure, though convalescence in empyema is tardy under the most favorable circumstances. If we observe from week to week some return of appetite, more cheerfulness and sleep, easier breathing, and less frequent cough, the case can be left to hygienic management and restorative medicines. If, as is probable, the improvement be only temporary, and after some days examination show that the liquid has reaccumulated to nearly or quite its former quantity, and symptoms occur which indicate the need of surgical interference, the operation should be repeated. The use of a small trocar produces no shock or prostration, and very little more pain than occurs from the hypodermic injection of medicine.

It seems to be a belief in the profession that pus in the pleural cavity should be evacuated as soon as discovered, without regard to the duration of the pleurisy, or the amount of distention and pressure. But in cases of its early evacuation—as, for example, when the inflammation has continued two weeks—patients have not in my practice done so well as when ten or twelve weeks have elapsed and the pleural surface has become thickened and less vascular.

In most cases the pleural cavity refills with pus in a few weeks after

aspiration, and the operation is again required. After three or four aspirations, if the secretion of pus do not appear to diminish, a free incision should be made with the knife at the same point as that selected for aspiration—that is, between the eighth and ninth ribs, and in the line passing perpendicularly through the lower angle of the scapula. An incision should be made with a sharp-pointed bistoury a little nearer the ninth than the eighth rib, sufficiently large to admit the blunt-pointed bistoury, and with this the incision should be extended to the distance of one-third to one-half inch, which will allow the pus to flow out freely. The opening should then be covered by oakum confined by long strips of adhesive plaster. Pus may or may not continue to flow into the oakum. If it do not the opening will close, if left to itself, within two or three days. No tent or drainage-tube is employed, for reasons to be mentioned hereafter. The physician should return after twelve or twenty-four hours, not later, and should introduce through the opening the ordinary gum-elastic male catheter, warmed so as to be flexible, and strongly bent at its middle. The point should be directed to the bottom of the cavity. Perhaps the soft rubber catheter might be preferable, but I have never used it, being satisfied with the other. The catheter should be attached by tubing to the exhausting-syringe or bottle, and any pus in the depending portions of the cavity will be readily removed. I have generally, at this visit, removed from the bottom of the cavity two or three ounces, sometimes very thick, and such as would not readily flow from the opening. Every day or twice daily the operation should be repeated, which will, I think, more effectually remove the pus than washing out the cavity, and the opening cannot close. This operation detains the physician only a few moments. The catheter should be a No. X., and it is the best possible probe. By the close of the first week the opening becomes fistulous.

After each removal of the pus, long strips of adhesive plaster firmly applied over the ribs, from the sternal region downward and backward, facilitate approximation of the pleural surfaces and obliteration of the cavity. During convalescence, the patient, if old enough, should be directed to make full inspirations, which serve to expand the lungs.

That so simple and important an operation as thoracentesis should have been known and practised by the ancients, even, it is said, by Hippocrates, and have fallen into disuse, till it was revived, in our own times, by Bowditch and Trousseau, seems remarkable. This was probably in part due to the bad instruments employed, and in part to the fact that in olden times the operation was performed in the anterior walls of the chest, where adhesions are frequently present. But there are certain accidents and unfavorable results of the operation which may be profitably considered, since they can nearly always be avoided.

1st. *The Admission of Air into the Pleural Cavity.*—This is unnecessary, and can be avoided; but those who have often witnessed the operation, as ordinarily performed, have remarked the fact that the admission of more or less air is common.

The entrance of a certain amount of air into a serous cavity, when the serous membrane is in its normal state, does not appear to be productive of harm with ordinary precautions, as regards temperature,

etc., as in ovariotomy, in which air is admitted into the largest serous cavity in the body; and the moderate admission of air into the pleural cavity, when the pleura is healthy, does not, as a rule, produce any ill effect. Thus a case is related of a man who suffered from heart disease, and was led to think that the pressure of a small amount of air internally might be substituted for external pressure, which always gave relief.[1] He was his own instrument-maker and operator. He constructed a small tube about as slender as a common pin, to which a bladder was attached filled with air. The point of this was thrust through an intercostal space till it penetrated the pleural cavity, and air was made to enter by compressing the bladder. Relief always followed, and the patient's health improved. This treatment was continued two or three years. Dr. Lizars, who was present at the meeting of the Medical Society before which this case was related, stated that he had performed a similar operation on four or five patients affected with aneurisms, with some apparent benefit, and in no case with injury.

But the condition is very different if there be inflammatory products in the cavity. It is a fact known to all observers that animal liquids withdrawn from the circulation, and escaped from the vessels through injury or disease, remain in a closed cavity for a lengthened period without putrefactive change, as for example a clot of blood under the scalp or pericranium of a newborn infant; but if air be admitted, it becomes offensive within a few hours. The admission of air into the pleural cavity which contains exuded products undoubtedly promotes putrefactive changes in the latter, and the admission of even a small amount of air, containing, as it does, microörganisms, which multiply rapidly in the animal fluids, and which appear to be the active agents in putrefaction, suffices to convert sero-fibrin, or laudable pus, into an offensive, irritating, and poisonous liquid, which increases the constitutional disturbance and the gravity of the disease.

Air in the pleural cavity, in proportion to its quantity, also tends to prevent the approximation to each other of the pleural surfaces and the obliteration of the cavity, which is required in all empyemic cases, since it is the mode of cure. Obviously the entrance of air does less harm if there be a fistulous opening and pus escape as soon as it forms, than in a closed cavity, but it should, in all instances, be avoided, as never beneficial, and likely to do harm in the manner indicated. It is never a necessary accident of thoracentesis, since it can be avoided by the use of proper instruments provided with India-rubber packing and stop-cocks. There can be no doubt, also, that the point of the aspirator has often so pricked and torn the lung, that air has entered the cavity from this organ—a result avoided by judiciously using the trocar and canula.

2d. The lung is sometimes injured by the point of the hypodermic needle, employed for diagnosis. Cases are recorded in the hospitals of New York, of the breaking off and loss of the needle in the lung, from sudden and strong movement of this organ, as in coughing. The most severe injury is, however, commonly produced by the aspirator needle, and some very serious cases of this accident have occurred, in which the

[1] London Lancet, January 15, 1831.

needle so pierced and tore the lung that not only air escaped from it, but also a considerable quantity of blood. It is obvious that the danger of injuring the lung is greater in recent than in chronic cases, and greater in sero-fibrinous than in purulent pleuritis, for a thickened, infiltrated, and firm pleura affords protection to the lung. It is very difficult to avoid injuring this organ if suction be made and the liquid be withdrawn with the unguarded point of the aspirator needle projecting into the chest. The removal of the liquid necessitates the impinging of the lung upon the point of the instrument even if it be held very obliquely, and in recent cases, when there is little thickening and infiltration of the pleura, the surface of this organ may be pricked or torn sufficiently to allow air to escape, and hemorrhage occur, when the operator who holds the needle can scarcely believe that such an accident were possible, so slight has been the sensation communicated to the fingers. Thus thoracentesis was performed on an infant of two months who had severe empyema of short duration. The instrument was held by myself obliquely, and it entered the pleural cavity only a short distance, and yet the lung was injured in three places, from which it was probable, from the signs and symptoms, that air had escaped. The specimen showing the injury was exhibited to the Pathological Society in 1879. Obviously, to prevent this injury, aspiration should be performed through the covered needle, as that of Phelps, or Potain's, or, which I have recommended above, and prefer, the trocar. I must here repeat what has been stated above, not to plunge the trocar to a greater depth than is needed, which is about one inch. The end of the canula may also injure the lung if it be pressed in too deeply, since it is necessarily rather sharp from its small size.

3d. *Washing out the Pleural Cavity.*—Since the aspirator has come into general use, it is the common practice to wash out the pleural cavity with carbolized water in the treatment of empyema. The proportion of carbolic acid to water commonly employed is about one part to eighty, and at a temperature of 100°. From a discussion at the meeting of the New York Surgical Society, Oct. 12, 1880, it appears that the use of carbolized water involves risk of carbolic acid poisoning in case the liquid be only partially removed after it is thrown into the pleural cavity, and the late Prof. Erskine Mason was in the habit of employing salicylic acid, one part to one hundred of water, in place of carbolic acid, since it possesses all the advantages with none of the possible risks of the latter. He stated that it promptly deodorizes fetid pus even in the proportion of one part to two hundred. The use of carbolic acid would probably be entirely safe if the liquid were removed immediately after washing the cavity, but for some reason this is not always possible. In case of an infant with empyema under treatment by Drs. Lockrow, Billington, and myself, after removing the pus by trocar and canula attached to the exhausting-bottle, and once washing out the pleural cavity, the liquid was thrown in a second time, ℥iij into the left pleural cavity of an infant of five months, but not a drop of it could be removed. There was, however, no symptom which we could refer to the carbolic acid. In view of these facts, and the possible

danger of carbolic acid poisoning, the use of salicylic acid appears to be preferable, at least for children, who are less able to resist the action of poisonous agents than adults.

In this connection I must state my conviction that washing out the pleural cavity is unnecessary if empyema be treated as recommended above, and it may be injurious. But it is proper treatment when the pus has undergone decomposition, is offensive to the smell, and therefore poisonous. If it be putrid, its immediate disinfection as well as removal from the pleural cavity appears to be clearly indicated, but in the common form of empyema, as the pus escapes through the opening which has been made, and the suppurative cavity becomes smaller, adhesions of the pulmonary and costal surfaces occur, which the injection of water may tear up and destroy, and thus the obliteration of the cavity is retarded. Letting out the pus and approximation to each other of the pleural surfaces are the indications as regards surgical measures. Besides, washing out the pleural cavity is not devoid of danger. Alarming symptoms may be developed unexpectedly and rapidly, even when the operation is slowly and cautiously performed. The infant of five months, with empyema, whose case I have alluded to, furnished a striking example of this. Four ounces of pus had been removed through a small canula from the left pleural cavity, and without removing the canula the cavity had been once washed out. It was proposed to repeat the washing, as the infant had thus far tolerated the operation, and was in an unusually favorable state for a case of empyema. The patient was in a semi-erect position, and three ounces of water at a temperature of 100° had entered the cavity from the inverted bottle, when he began to cough, fretted, and became very restless. Immediately Dr. Lockrow applied the suction-point of the syringe to the tubing, and attempted to withdraw the liquid, but with no result. The patient's face assumed a deadly pallor, he frothed at the mouth, his lips were compressed, and breathing ceased. He was to all appearances dead. He was immediately placed upon the back by Dr. Billington, and by prompt resort to artificial respiration, the terrible suspense was soon ended by the gasps of the child, and the return in a few moments of consciousness and normal respiration. It seemed to me that this untoward accident was due to the flow of water against the heart, so that it prevented full dilatation of its cavities, and, consequently, diminished the flow of blood into the aorta and produced anæmia of the brain. Lichtenstern says: "Various causes, which sometimes quite interrupt or impede the flow of blood to the left heart, such as severe paroxysms of coughing, vomiting, lifting heavy burdens, may give rise to a suddenly fatal anæmia of the left heart, and secondarily of the brain. The anæmia of the lungs or brain found in many cases is only of secondary importance. It frequently happens after thoracentesis with aspiration that an anæmia is produced in the partially distended lung, and this may lead to death by asphyxia. In sudden death during, or immediately, or a short time after thoracentesis by aspiration, the cause is anæmia either of the heart or brain. In cases in which severe syncope and sudden death are observed during the irrigation of the pleural cavity, the cause is either

direct mechanical concussion of the easily exhausted heart, by the stream of water thrown in, or shock."[1]

4th. *The Use of Tent and Drainage Tube in Empyema.*—With due regard for the opinions of the experienced surgeons who employ and recommend the tent and drainage tube, but whose observations have been largely upon adult cases of empyema, I cannot recommend their employment for children, unless perhaps the tent for a day or two after the incision; but the tent is not necessary if the catheter be daily introduced in the manner which I have advised. The drainage tube almost necessarily admits air during inspiration, but this is not the most serious objection to it. Cachectic children with poorly nourished tissues badly tolerate pressure upon an open wound by a hard substance. It is liable to cause ulceration and enlarge the opening, and continued pressure of the tube may cause periostitis upon the edge of the rib and necrosis. Scrofulous and feeble children are very prone to both caries and necrosis from even slight pressure or bruises upon the surface of the bone—a result to which adults are much less liable. In a paper published by Mr. W. Thomas,[2] on the treatment of empyema by resection of one or more ribs, nine cases are detailed, in three of which necrosis had occurred from pressure, it is stated, of drainage tubes, thus necessitating the removal of the diseased portion. During the year 1881, a wasted empyemic infant was brought to one of the institutions of this city for treatment. After letting out the pus, a drainage tube was introduced and secured. At the next visit ulceration had so enlarged the opening that a large amount of air entered the chest with a whistling noise at each inspiration, and was expelled during expiration, and necrosis of the portion of the rib against which the tube pressed had also occurred. Air was finally excluded by covering the opening with a cloth smeared on each side with a concentrated solution of gutta-percha in chloroform, but the case after some days ended fatally. The escape of the drainage tube into the pleural cavity, which has occurred by breaking of the threads which secured it, is so rare an accident that it does not constitute an objection to the introduction of the tube; but aspiration daily or twice daily through the catheter so completely removes the pus that drainage is not required, and the risk of injury by the pressure of the tube is therefore avoided.

5th. I have witnessed, in a few instances, the burrowing of pus under the skin at the point where an incision had been made to let out the pus. This complication may lead to more or less ulceration or sloughing, and it greatly increases the danger of poisoning. But infiltration of pus will almost never occur if the incision be direct through the tissues and not with the skin pushed to one side, so that it forms a covering or valve when it returns, as was once recommended in the books as a means of excluding air. But air does not enter the cavity through a direct opening if it be properly covered after the pus has escaped. Burrowing of pus and pyæmic poisoning therefrom cannot then be re-

[1] Deutsches Archiv für Klin. Med., Band IV., 4 Heft. London Med. Record, Dec. 15, 1880.

[2] Birmingham Med. Rec., 1880, N. S., vol. iii.

garded as an accident of the mode of operation which I have recommended.

Exsection of a Portion of one or more Ribs.—This operation has now been performed a considerable number of times in Europe and in this country, and, from the published accounts, certain cases have apparently recovered more rapidly in consequence. Thus in one case a fistulous opening, spontaneously established, had continued several months, with little diminution in the discharge, and very slow progress toward recovery, when by this operation, which produced a larger opening and a freer escape of pus and falling in of the chest-wall, so as to obliterate the cavity, the patient rapidly convalesced.

The alleged benefit from the exsection, which consists in the removal of an inch or a little more of one or more ribs, in or near the site for the usual performance of thoracentesis, is, that there is a readier escape of pus and the facility for washing out the pleural cavity is increased, and the thoracic wall and lung more readily approximated so as to produce obliteration of the pleural cavity. The greatest benefit is claimed for it in those cases in which the intercostal spaces are small and the ribs lie close to each other.

Without denying that certain cases have apparently been benefited by the operation, I must say that I have not yet met a case either in family or hospital practice, in which I could conscientiously recommend the operation, except where necrosis had occurred from a periostitis produced by the irritating property of the pus, or the pressure of a drainage tube. The gum-elastic catheter, introduced as recommended above, will pass through any intercostal space which I have yet observed, so as to allow free evacuation of the pus by suction, if it be not incapsulated by fibrinous bands, and allow also the free washing out of the pleural cavity if this be desired.

There are also serious objections to the exsection in case of a child. The system, exhausted by suppurative inflammation, is in poor condition to tolerate an operation of any severity, and although we are directed to preserve as far as possible the periosteum from injury by the knife, and be careful not to wound the intercostal vessels, there are necessarily more or less shock and hemorrhage and consequent danger of hastening the death of the patient. In one of the cases, that of an infant, reported by an advocate of the operation, it seems to me that death was largely attributable to the exsection.

In order that exsection aid materially in the approximation of the lung and ribs, it is necessary to remove portions of two or more ribs, and the greater the operation the greater the risk. But what is needed is not depression of the ribs, which may produce permanent deformity, but expansion of the lung, and this is promoted by the integrity and resiliency of the ribs.

Nervous Cough.

A nervous cough sometimes occurs in children, especially between the ages of two or three and ten years. It may result from disease of the brain, from the second as well as first dentition, from some irritant in

the intestines, as worms, and also from spinal irritation. Occasionally there appears to be no local cause, but a state of anæmia, or a highly developed nervous temperament, to which it seems proper to ascribe the cough. Occurring under these last circumstances it corresponds with, and is sometimes accompanied by, functional disturbance in the action of the heart, as palpitation.

A nervous cough is short, painless, and without expectoration. It usually attracts little attention at first, but from its long duration the friends finally become anxious lest it betoken some serious disease. At times it may nearly subside if the patient lead a quiet life and the general health improve, and there are periods of recrudescence if the opposite conditions obtain. It may have a spasmodic character, especially in times of mental excitement, but in a less degree than the cough of pertussis. If not properly treated, it usually continues several weeks or months, disappearing as the general health and the tone of the nervous system improve. It is not in itself a serious disease, nor does it lead to any ailment or produce any injury of the respiratory organs, but it is an unpleasant malady, and is liable to be mistaken for incipient tuberculosis if it occur in one decidedly cachectic, and belonging to a family predisposed to phthisis.

TREATMENT.—If there be a local cause of the cough, measures calculated to remove this, or at least to palliate its effects, are obviously required. Especially should constipation, or any abnormality in the digestive function, be corrected. But in many cases there is no apparent local ailment which produces the cough by its irritative action, and the remedial measures must then be twofold, to wit, measures designed to improve the general state, and, secondly, measures designed to relieve the cough. Such measures are also required in most cases in which there is a local cause, provided that the cough do not cease when treatment calculated to remove this cause has been employed.

For constitutional treatment no remedy is so useful in ordinary cases as iron. The following example shows the benefit which may result from the use of this agent, since in this case it effected a cure without the aid of other measures. B—, aged 11 years, pallid and of spare habit, but active, and with good appetite, had been treated for this malady by different physicians but without improvement. His mother had died of tuberculosis, and some at least of the physicians believed that he was in the commencement of the same disease. Finally he was placed under the care of the late Dr. Cammann, who, detecting the nature of the malady, wrote the following prescription:

℞.—Ferri. subsulphat. . . . . ℥ss.
Acid. nitric. . . . . f℥ss.
Aq. destillat. . . . . f℥ss.—Misce.
Dose, three drops four times daily in sweetened water.

The cough disappeared in a surprisingly short time. If the appetite be poor, the vegetable tonics are required in combination with iron.

If the cough be frequent and troublesome, medicines which exert a direct controlling effect upon it are required in addition to the medicines and measures employed to improve the general state. For this purpose

no remedy is so useful as the bromides, employed alone or in combination with belladonna. If there be no decided anæmia, and no local cause of the cough, the bromides and belladonna usually effect a cure without the employment of constitutional measures, or if the case seem to require iron it may be given in the interval. The following is the prescription for a child of three years:

℞.—Tinct. belladonnæ . . . . . gtt. xxxij.
Potas. bromid.
Ammon. bromid. . . . . āā ʒj.
Syr. simplic. . . . . ʒij.—Misce.
Dose, one teaspoonful twice daily.

In 1871 I was asked to prescribe for a German boy, aged 8½ years, who had a cough of this kind of two months' duration, which latterly had been frequent and annoying. Within a week he was entirely relieved without other remedy, by the employment of tincture of belladonna, drops v, and bromide of ammonium, gr. v, twice daily. Outdoor exercise, or country residence, and other regimenal measures which improve the general health, are useful in ordinary cases.

SECTION III.

DISEASES OF THE DIGESTIVE APPARATUS.

CHAPTER I.

SIMPLE STOMATITIS, ULCEROUS STOMATITIS, FOLLICULAR STOMATITIS.

Diseases of the digestive system are very frequent in infancy and childhood. They are for the most part readily recognized, and are more easily and quickly controlled by therapeutic agents, if rightly applied, than are the diseases of any other system. If misunderstood and improperly treated, they may, even when mild and very manageable in their commencement, become chronic and obstinate, or even fatal, or they may lead to other and more dangerous diseases. It is necessary, then, that the physician should understand thoroughly the pathology as well as therapeutics of the digestive system, that he may make timely and correct use of the required remedies.

The diseases of the buccal cavity in early life are for the most part inflammatory. The mildest is that known as

Simple or Catarrhal Stomatitis.

This form of catarrh occurs usually before the completion of first dentition, and it is most frequent under the age of one year. Giving rise in itself to no severe symptoms, and often being connected with other grave and dangerous maladies, it is, doubtless, in many cases overlooked. It is sometimes confined to a portion of the buccal surface, or is more intense in one part than in another. In other cases the catarrh is uniform, or nearly so, affecting the entire cavity of the mouth.

Causes.—The common cause of simple stomatitis in infants is the same as that of most cases of gastro-intestinal inflammation at that age. This is the use of indigestible and therefore irritating food, uncleanliness, personal and domiciliary; in fine, all those agencies which impair the general health, and enfeeble the digestive organs. Therefore, stomatitis, like entero-colitis, is more common in the city than in the country, and among the city poor than those in the better walks of life. Infants deprived of the mother's milk, and given a diet which, with all care of preparation, is a poor substitute for the natural ailment, are

very liable to this disease. Beaumont ascertained from his experiments on St. Martin that irritative changes produced in the stomach by indigestible substances were soon followed by similar changes in the buccal mucous membrane. Since in young infants any kind of artificial food is less digestible than breast milk, it is evident why those who are prematurely weaned or are carelessly fed are so liable to stomatitis. This inflammation is also sometimes due to irritating substances taken in the mouth, as drinks habitually too hot or too cold. Stomatitis is also present in measles and scarlet fever. It then corresponds with the cutaneous eruption, and disappears when that subsides.

Another cause is dentition. The gum over the advancing tooth first becomes inflamed, and, other causes perhaps conspiring, the inflammation extends over more or less of the buccal surface. When due to dentition the stomatitis is more frequently partial than when it arises from a constitutional cause. Mercury, in whatever form introduced into the system, excreted from the salivary glands, and flowing over the buccal surface, is an occasional though nowadays rare cause.

Symptoms—Appearances.—Stomatitis, like other mucous inflammations, is characterized by increased redness and more or less thickening of the inflamed buccal membrane, by rapid proliferation and exfoliation of epithelial cells, and by an increased functional activity of the muciparous follicles. The heat of the mouth is sometimes augmented in an appreciable degree. The gums in severe cases are swollen and spongy, and bleed easily if rubbed or pressed. The tongue is usually covered with a light fur, and the salivary secretion is frequently augmented to such an extent as to dribble from the corners of the mouth. Often there is little suffering, but in other instances the patients are fretful, experience pain from the contact of solid food, and, if nursing, may even wean themselves from dread of pressure of the nipple.

Simple stomatitis is not difficult of detection, provided that attention be directed to the mouth. Inspection informs us of its presence and extent. A favorable termination may be confidently predicted, unless there be a state of marked cachexia, or a grave coexisting disease. If circumstances are unfavorable, simple stomatitis may terminate in a more severe form, as the ulcerous or diphtheritic.

Treatment.—The physician should endeavor to ascertain the cause, and, if possible, should remove it by appropriate medicinal or hygienic measures. Sometimes no special treatment is required, as in measles or scarlet fever. When the primary affection terminates, the stomatitis disappears of itself. If dentition be the cause, and there be much fever and fretfulness, it has been the common practice to scarify the gums, but this operation is not often advisable. A few doses of bromide of potassium relieve the fretfulness, and mucilaginous and mild astringent lotions suffice for the catarrh. Borax is a good local remedy used either with honey or with glycerine and water; one part of borax to three of honey, or a drachm of borax to an ounce of glycerine and water. A weak solution of alum is also a useful topical remedy. With either of these agents in a favorable condition of system, and without any serious coexisting disease, the stomatitis is relieved.

Ulcerous Stomatitis.

In ulcerous stomatitis, the anatomical characters are those of severe simple stomatitis, with the additional element which gives it the name by which it is designated.

The inflammation usually begins upon the gums and extends along the buccal surface. Little white points soon appear upon the under surface of the mucous membrane, producing slight prominence of it. These points, which are inflammatory exudations, mainly fibrinous, gradually enlarge. Some unite and give rise to large irregular ulcerations; others remain isolated, producing ulcers which are smaller and of more regular shape. There is, indeed, no uniformity as regards the size and form of the ulcers. In the folds of the buccal membrane they are usually elongated, while inside the lips, or where the surface is smooth, the circular or oval form predominates. It is a noteworthy fact that the exudation underlies the mucous membrane, obstructing its nutrient vessels, so that the ulcer which results causes destruction of the mucous layer, and cure is effected by cicatrization.

Ulcerous stomatitis is usually confined to that part of the buccal surface which covers the gums, or is in their immediate vicinity, but in some instances it affects nearly every part of the cavity of the mouth.

If the disease be severe, considerable swelling occurs around the ulcers, but the swollen part is soft and cushiony, and not very tender on pressure. The soft and yielding nature of the swelling serves as a means of diagnosis between this disease and the premonitory stage of gangrene, since in the latter affection the swollen part is more indurated.

If the disease grow worse, more ulcers appear, and those already present grow deeper and wider, and their edges more vascular.

If, on the other hand, there be improvement, the swelling subsides, the ulcers become more clean, their bases approach the level of the mucous membrane, and present a granulating appearance. Finally the mucous layer is reproduced. A considerable time after the ulcers are healed, the new membrane which occupies their site has a redder hue than the adjacent surface.

Causes.—Ulcerous, like simple stomatitis, is most frequent in the families of the poor. Personal uncleanliness, poor food, a residence in apartments dirty, humid, or in other respects insalubrious, favor its development. In fine, a cachectic condition, however produced, is a common predisposing cause. Ulcerous stomatitis frequently occurs when the system is reduced or enfeebled by acute diseases, as after the essential fevers and thoracic and intestinal inflammations. In protracted enterocolitis of infants, it is sometimes severe and obstinate, and a case in which this complication arises usually ends unfavorably. The abuse of mercury is an occasional cause of this form of stomatitis, as well as of simple catarrh. Jaccoud states that Bergeron established the fact that ulcerous stomatitis is propagated among soldiers by contagion, and he adds "it is very probable that it is the same in infants."

Symptoms.—The symptoms in ulcerous stomatitis are more severe than in the simple form. There are more pain, more salivation, and more fretfulness. The ulcerated surface is sometimes very tender, so that there is but little sleep. Drinks, unless bland and lukewarm, are painful, and, if the ulcers be on the lips or the front of the mouth, the infant nurses less eagerly than usual, and even with reluctance, sometimes weaning itself. Occasionally the submaxillary glands are tumefied, hard, and tender. The breath has an offensive odor. In mild cases, in which the stomatitis is of limited extent, this odor may scarcely be noticed, but in severe cases it is almost like that exhaled from putrid substances. The febrile movement is usually slight.

Prognosis.—A favorable prognosis may be given unless the patient be in a decidedly cachectic condition, or there be a serious coexisting disease, under which circumstances the case may be protracted. If death occur, it is due to the cachexia, or to some pathological state quite distinct from the stomatitis, most frequently entero-colitis. Ulcerous stomatitis, when the ulcers are small and the inflammation of limited extent, is of course more easily cured than when it is extensive and the ulcers are large.

This disease is very liable to return, unless the general health be good.

Treatment.—The physician should endeavor to ascertain the cause of the stomatitis, and so far as possible should remove the patient from its influence. It is often necessary, in order to insure speedy recovery, to recommend a change in regimen, especially as regards diet and cleanliness. If the patient live in damp, dark, and dirty apartments, the family should seek a better residence, and he should be taken daily in the open air.

Tonic remedies are generally required. The ferruginous preparations may be advantageously given, or the vegetable tonics, or the two in combination. In selecting the internal remedies we must regard the antecedent disease, if there be any, which the buccal inflammation complicates, and on which it depends. For that large proportion of cases in which there is chronic intestinal inflammation, the liquor ferri nitratis with tincture of colombo administered in simple syrup will be found useful. For local treatment Trousseau recommends occasional applications of nitrate of silver or muriatic acid as a caustic, and in the intervals a wash of equal parts of borax and honey.

The chloride of lime is also considerably used in Paris. It is recommended by Rilliet and Barthez. It is applied dry to the ulcerated surface twice daily, and in the interval the mouth is washed with simple water. This treatment is continued till the ulcers present a healthy appearance and begin to cicatrize. Then a weak solution of chloride of lime is employed, one grain to forty-five of the vehicle. By this treatment a cure is usually effected. Bouchut prefers using chloride of lime with honey, one drachm to the ounce.

But painful applications are not required. The remedy which is most employed in this country and in Great Britain is chlorate of potassium. It often acts like a specific for this as well as other forms of stomatitis. It may be given dissolved in water with sugar, or with one of the syrups,

to render it more palatable. The dose is about two or three grains every two hours. It should be allowed to run over the affected part, as it is believed to have a local action.

℞.—Potass. chlorat. . . . . ℥ss–j.
Mellis . . . . . ℥ss.
Aquæ . . . . . ℥ij.
One teaspoonful every two hours.

Of all topical remedies in common use, chlorate of potassium is probably the most efficacious. Some physicians prefer the chlorate of sodium on account of its greater solubility. If this wash be too painful in consequence of the irritable state of the ulcers, it may be mixed with mucilage or be employed less frequently, and borax applied in the interval.

Aphthous Stomatitis.

Aphthous stomatitis may occur at any age, but it is most frequent in childhood. It is sometimes designated follicular stomatitis, but the disease affects the contiguous mucous surface, as well as the seat of the follicles. At first a vascular injection is observed, and within a few hours a whitish exudation occurs immediately under the epithelium, and upon the corium, in small round or oval isolated spots. The smallest of these patches are not larger than a pin's head, but most of them have a diameter of one to two lines, and they cause slight prominence of the surface. In two or three days the exudation softens, and the epithelium which covers it is thrown off, producing an ulcer, superficial, without induration of its edges, but sensitive to the touch. It heals in one to two weeks, leaving only a reddish spot or stain, which soon fades. Sometimes two or more aphthæ unite, forming a patch, and an ulcer of correspondingly large size. The seat of aphthous stomatitis is usually the internal surface of the lips and cheeks, the gums, tongue, and occasionally the roof of the mouth.

Causes.—Probably in most instances the exciting cause is some derangement of the digestive organs, which may not be appreciable. We sometimes observe this form of stomatitis in cases of diarrhœa. Occasionally, especially in spring and autumn, two children in a family are affected at the same time, or two or more in a school, so that the disease presents an epidemic character. Children surrounded by bad hygienic conditions, as in the tenement houses of cities, are more liable to this as well as other forms of stomatitis, than are children who live in clean, and airy localities, and have nutritious and wholesome diet.

Symptoms.—The constitutional symptoms in a large proportion of cases of aphthæ are slight. In twelve children affected with this disease Billard found the pulse from sixty to eighty beats per minute.

The ulcers are painful, as is indicated by the cries of the child when they are pressed, and its fretfulness. Solid food and even drinks, unless bland and unirritating, are badly tolerated. The salivary secretion is also augmented.

In those rare cases in which the ulcers become confluent or gan-

grenous, the state of the patient is really serious. There is then often gastro-intestinal disease. The symptoms indicate prostration. The pulse is feeble, the countenance pallid, and the body and limbs become wasted.

Diagnosis.—This is easy. The only disease with which it is liable to be confounded is ulcerous stomatitis. In the ulcerous form there is antecedent and accompanying stomatitis affecting a considerable part, if not the entire buccal cavity, while in the follicular form the inflammation is ordinarily confined to the immediate vicinity of the ulcers. The character of the ulcers serves also as a means of distinction. In ulcerous stomatitis there is great variety as to size and form, while in aphthous stomatitis there is great uniformity in both these respects. The small, circular ulcers are characteristic of the follicular inflammation. Before the ulcerative stage the circumscribed character of the eruption serves to distinguish this form of stomatitis from other local diseases affecting the cavity of the mouth.

Prognosis.—Aphthous stomatitis usually ends favorably; but, if the ulcers become concrete or gangrenous, the health is seriously affected, and a more cautious prognosis should be expressed. The unhealthy appearance of the mouth and the real danger are more often due to the depressing effect of some concomitant disease than to the stomatitis.

Treatment.—In ordinary aphthous stomatitis, which is discrete and attended by little or no constitutional disturbance, local remedies suffice to cure the disease. Demulcent drinks or applications to the mouth should be used, as the mucilage from gum acacia, marshmallow, or flaxseed. Mild astringent lotions with the demulcent are also beneficial. The mel boracis is one of the best and most agreeable applications. It may be placed in the mouth with a spoon, or applied with a camel-hair pencil. If there be much tenderness of the ulcers, with restlessness, a small quantity of some opiate should be added to the lotion, or it may be administered separately.

With this simple treatment the ulcers generally soon heal, and the health of the patient is restored. If, however, the ulcers be painful, and not disposed to heal, or be healing tardily, they may be touched lightly with a pencil of nitrate of silver, or, as Barrier recommends, hydrochloric acid in honey of roses. This diminishes the tenderness and expedites the healing process. A better remedy is iodoform, two drachms to one ounce of ether, and applied to the ulcers by a camel-hair pencil.

If, as may in rare cases occur, the ulcerations be numerous, and accompanied by considerable fever, there may be symptoms indicative of cerebral congestion, or even premonitory of convulsions. In such cases laxatives and the soothing effect of one of the bromides and sometimes of the warm foot-bath are required.

If there be an unhealthy appearance of the ulcers, if they gradually enlarge or become concrete, or gangrenous, indicating a cachectic state, tonics should be employed with nutritious and easily digested diet, and antihygienic influences should so far as possible be removed.

CHAPTER II.

THRUSH.

THE terms thrush, sprue, and muguet, the last from the French, are synonymous. They are used to designate a particular form of inflammation of mucous surfaces, the peculiar feature of which is the presence of points or patches of a curdlike appearance on the inflamed surface.

The usual seat of thrush is the buccal membrane, but occasionally it affects the faucial, pharyngeal, or œsophageal surface. It is rare in the subdiaphragmatic portion of the digestive tube, but a few such cases have been reported by Billard and others. It never affects the membrane of the nostrils, larynx, or bronchial tubes, and it very seldom occurs in any other part of the alimentary canal without also being present in the mouth. Thrush, then, is a stomatitis, pharyngitis, or œsophagitis, or a gastro-enteritis with the additional element which I have described.

ANATOMICAL CHARACTERS.—The first stage of thrush is that of simple inflammation of the mucous surface. There next appear minute semi-transparent points or granules, which, increasing, soon become white and opaque. Some of them remain as points, while others, extending, and perhaps coalescing with those adjoining, form patches of greater or less extent. The white points or patches are unequally elevated. Their central part, which was first formed, is most raised, while their circumference projects but little above the epithelium. Their highest elevation is not ordinarily more than a line above the surface. They are smaller in the pharynx and œsophagus than upon the buccal surface. They resemble closely, in color and consistence, portions of curdled milk, and the nurse often mistakes them for such, and neglects to call attention to the state of the mouth. They are readily detached by a little force, but are speedily reproduced. Their color in the first days of the sprue is white, and sometimes this color continues. In other cases they assume, if the disease be protracted, a yellow hue.

Their true nature, long unknown, was finally revealed by microscopy. They consist in part of epithelial cells, and in part of a vegetable growth. This parasitic plant is in most cases the oïdium albicans. Like other confervæ, it consists of roots, branches, and sporules. The roots are transparent, and they penetrate the epithelial layer, sometimes even to the basement membrane. The branches divide and subdivide at an acute angle, and under the microscope they are seen to consist of elongated cells, with one or two nuclei. Around these branches are numerous sporules. In two or three instances I have examined the product of thrush removed from the œsophagus, and in both the parasitic plant was the penicillium glaucum, or a conferva closely resembling it.

In the mildest form of thrush, this morbid product is in points or

small patches. If the patches be of large extent, especially if, as rarely happens, a considerable part of the buccal surface be covered by them, there is generally a state of great prostration and danger, from some antecedent or concomitant disease. Thrush is, indeed, often the sequel of some grave affection, as pneumonitis or gastro-intestinal inflammation. Its complication with the last-named disease is common in young, ill-fed infants, especially those deprived of the breast-milk, and such cases are frequently fatal.

Hence, some writers who have observed infantile diseases in foundling hospitals, regard thrush as one of the most serious maladies of early life. Valleix, in a book of seven hundred pages relating to diseases of children, devotes more than one-third to the consideration of muguet. Of twenty-four cases, the records of which he publishes, twenty-two died, but their death was due to gastro-intestinal inflammation, which the author considered a part of the more general disease, muguet. Doubtless the same cause which produced the stomatitis, with the confervoid growth, in these infants, also produced the fatal gastritis or gastro-enteritis, occurring without this growth. Nevertheless it seems better to restrict the term sprue, thrush, or muguet to those inflammations of mucous surfaces which are accompanied by the parasitic growth. I omit, then, from my description of the anatomical characters of thrush, those subdiaphragmatic phlegmasias which some writers consider an important part of severe muguet, and regard them as complications, unless indeed the case be one of those exceptional ones in which the parasite has lodged and grown upon the gastric or intestinal surface. This explanation seems necessary in order to understand the different statements of writers in relation, not only to the anatomical characters of thrush, but also in reference to its mortality.

The frequent coexistence of thrush with gastro-intestinal inflammation, has been remarked in the hospitals of Europe, and in the Infant Asylum and Foundling Asylum, in this city. In the post-mortem examinations of those who have died in these institutions, having thrush at the time of death or immediately prior to it, and who for the most part have been infants under the age of three months, I have frequently found evidences of inflammation in every division of the alimentary canal. The confervoid growth was, however, seldom seen below the fauces, and never below the œsophagus.

Symptoms.—The symptoms in thrush are not different in most patients from those of simple inflammation. In the mildest cases they are chiefly of a local nature, such as have been already described in our remarks on simple stomatitis. If the inflammation be more extensive, especially if it affect the fauces and œsophagus, the infant becomes feverish and fretful, and the inflamed surface is hot, red, and tender. In the worst forms of thrush this surface not only presents the ordinary features of severe inflammation, to wit, heat, redness, and tenderness, but it is sometimes deficient in the natural secretion, so as to present a dry or parched appearance. It is in these cases that there is often a more extensive inflammation than that of the buccal or œsophageal membrane. The subdiaphragmatic portion of the digestive tube is inflamed. In this severe form of sprue, thirst, loss of appetite, restless-

ness, vomiting, and frequently diarrhœa occur. The countenance is anxious and pallid; there is rapid emaciation, and, if the disease be not arrested, a state of extreme prostration soon arrives. The twenty-four severe cases related by Valleix, already alluded to, twenty-two of which were fatal, were examples of this severe form.

CAUSES.—Thrush most frequently occurs in those who are constitutionally feeble, or who are enfeebled by disease or by unfavorable hygienic conditions. Cachexia is a cause common to thrush and most other subacute inflammations of the alimentary canal. The most obvious and common of the unfavorable hygienic conditions alluded to is the continued use of indigestible and improper food. It is, therefore, a common disease among foundlings, in institutions where these unfortunates are received, since they not only breathe an atmosphere which is often impure, but are deprived of the mother's milk, and are so frequently given a diet which is a poor substitute for it. Among the destitute of the cities thrush is common, since with them, from necessity or choice, there is the greatest neglect of sanitary requirements. Exposure to humidity, to variations in temperature, increases the liability to the disease, though in less degree than defective alimentation. Billard and Valleix agree that thrush is more frequent in the warm months than in the cold, that its maximum frequency is in the months of July, August, and September. Cases in the Infant Asylum and Child's Hospital of this city, have appeared to me to correspond in this respect with those related by Billard and Valleix. Various writers have mentioned the age at which thrush most frequently occurs as one of the predisposing causes. Uncomplicated thrush is not common above the age of six months. Most cases occur under the age of three months. Infants at the age of one or two weeks, if in addition to lactation they are spoon-fed by nurses overanxious that they should thrive, are liable to take the disease. Thrush is not common in children under the age of eighteen months who are suffering from exhausting diseases. It is then an unfavorable prognostic sign.

DIAGNOSIS.—This is easy so far as thrush in the mouth is concerned, for simple inspection by one familiar with the disease is all that is required in order to discover it. The presence of thrush in portions of the alimentary canal hidden from view cannot be positively ascertained.

The vomiting, diarrhœa, pain or fretfulness, emaciation, and rapid sinking, which sometimes accompany severe forms of thrush, indicate gastro-intestinal inflammation, to which the attention of the practitioner should be chiefly directed.

PROGNOSIS.—The duration of thrush varies according to its intensity, and the favorable or unfavorable condition of the child. If it be slight and the health of the infant otherwise good, it may often be cured in two or three days. Under other circumstances it may continue as many weeks or even longer, before it is entirely removed.

When thrush occurs in connection with gastro-enteritis, the mortality is very great. It has been already stated that in Valleix's twenty-four cases twenty-two were fatal. M. Auvity estimates the mortality of such cases at nine in ten, and M. Godinat at two in three.

Treatment.—As one of the most common causes of thrush is the use of indigestible or improper food, the physician should ascertain the nature of the infant's diet, and if it be faulty, should direct a better. In many cases the infant is bottle-fed. It should be given only the mother's milk if practicable, or that of a healthy wet-nurse. This change of alimentation often removes the sole cause of thrush in the young infant, so that it rapidly recovers.

If artificial feeding be necessary, such diet should be advised as is directed in our remarks on the treatment of the diarrhœal maladies. There is often in thrush an excess of acids in the digestive tube, and an alkali is required. Trousseau recommends the addition of saccharate of lime to the milk. Children with this disease should also be taken from filthy and damp apartments, to those in which the air is pure and dry, and their mouths and persons should be kept clean.

The remedy in common use in the treatment of thrush, and which is usually effectual, is borax. This, if applied sufficiently often to the affected membrane, not only destroys the parasitic growth, but prevents its reproduction. It is commonly employed with honey, or in a powder with sugar or dissolved in water. The officinal mel boracis, consisting of one part of borax to eight of honey, is so much used in families that it may be considered almost a domestic remedy. There is, however, an objection to using an application for the removal of thrush which contains either sugar or honey, since either substance remaining in the mouth would rather promote the growth of the parasite. Still, it is desirable to employ a wash of such consistence that it will remain a longer time in contact with the buccal surface than will a simple solution in water. I know no better vehicle for borax than glycerine, which has the advantage of consistence, does not undergo any chemical change, and has no unpleasant flavor. Borax may be used dissolved in glycerine, with or without some flavoring ingredient:

℞.—Sodii borat. . . . . ʒj.
Glycerinæ . . . . . ʒij.
Aquæ . . . . . ʒvj.—Misce.

Borax should be used four or five times daily, and continued for a time after the disease has disappeared from sight, since the roots of the plant must be destroyed or the branches are rapidly reproduced. It should be applied by a camel-hair pencil, or with a soft cloth upon the finger, or a stick. It should be so freely used, in extensive and severe forms of the disease, that the infant will swallow some, since the entire œsophagus is liable to be affected in such cases. In the intervals between the applications of borax, if the buccal surface be hot, dry, and tender, so as to increase the fretfulness of the infant, it is well to use mucilaginous washes, as the mucilage of acacia or marshmallows. If the disease continue notwithstanding the use of these measures, the mouth should be occasionally washed with a weak solution of nitrate of silver or sulphate of zinc:

℞.—Zinci sulph. . . . . gr. ij–iv.
Aq. rosæ . . . . . ʒij—Misce.

In many cases, however, the treatment of thrush is of less importance than that of the disease which thrush complicates. The remedial measures which I have mentioned then become subordinate to those employed for the graver disease. When this disease is relieved and the general health improves, thrush is more easily and permanently cured than during the state of feebleness and ill-health.

CHAPTER III.

GANGRENE OF THE MOUTH.

THE diseases of the mouth which we have been considering are attended by little danger, but the one which we are next to consider is among the most fatal of early life. It is gangrene of a portion of the cheek or gums, or of both. It is described by writers under various names, as cancrum oris, noma, necrosis infantilis, aqueous cancer of infants.

ANATOMICAL CHARACTERS.—Gangrene of the mouth is sometimes preceded by ulceration of the mucous membrane, at the point where it is about to commence, but in other cases this membrane is entire. The tissues at the point of attack, which is most frequently the inside of the cheek, become inflamed, thickened, and indurated. The induration extends, and soon the purple hue of gangrene appears and increases. The next stage in the progress of gangrene is sloughing of the portion the vitality of which is lost.

The slough does not present the appearance of uniform decay. While the color is generally dark, there are in the mass fibres of connective tissue, or even bloodvessels which remain unchanged or are but partially decomposed. After separation or sloughing of the part where the vitality is first lost, the surface of the excavation, if the disease be not checked, has a dark, jagged, and unhealthy appearance. Commencing with the mucous membrane and the tissue immediately underlying it, the disease extends on the one side toward the skin, and on the other toward the deeper seated structures of the jaw. According to Billard, the swelling which precedes and surrounds the gangrene is in great part œdematous.

This disease is occasionally primary, but in a large proportion of cases it is secondary. Occurring secondarily, its symptoms are often masked by those of the antecedent and coexisting affection. Under such circumstances attention is sometimes first directed to the mouth, by the loosening of one or more of the teeth, or the appearance on the skin of a livid circular spot, which indicates the approach of the disease to the cutaneous surface. The mucous membrane presents a dark red

appearance for the distance of a few lines beyond the point of gangrene. It covers tissues which are inflamed and indurated and about to become gangrenous.

The tongue is usually more or less swollen, unless the disease be mild; an offensive odor arises from the gangrene, due to the evolution of sulphuretted hydrogen and other gases. There is great difference in the extent of the destruction, and the gravity of the disease, in different cases. It may sometimes be arrested by proper applications and a favorable change in the general health of the child at an early period, when there is little loss of substance. In other cases it extends till it perforates the cheek, or even destroys a considerable part of the side of the face, and, extending inward, attacks the periosteum of the maxillary bone, destroying the gum and teeth, and denuding the alveoli. Recovery, if it take place at all under such circumstances, is with the loss of a portion of the bone, and with deformity.

The duct of Steno is sometimes included in the gangrenous portion, but it commonly resists the destructive process, and remains pervious.

Age.—The age at which gangrene of the mouth occurs is usually between two and six years. In twenty-nine cases collated by Rilliet and Barthez, twenty-one were between the ages of two and six years, and the remaining eight between six and twelve years. Of the cases which have fallen under my observation, most were between the ages of two and six years. It is seen that the period of greatest frequency of gangrene of the mouth is different from that in which the ordinary forms of stomatitis occur.

Gangrene of the mouth may, however, occur under the age of one year. Billard reported three cases under the age of one month, but in two of these the disease does not appear to have been sufficiently marked to render it certain that they were genuine cases.

Causes.—Gangrene of the mouth usually occurs in those whose systems are reduced or cachectic. It is, therefore, more frequent among the poor than those in comfortable circumstances; in the city than in the country. It is more frequently observed in asylums for children than in private practice. Most of the cases which I have seen have been in these institutions. If the constitution be good, it can only occur in those long deprived of pure air and wholesome nutriment, or those enfeebled by disease.

Among the diseases which have been known to terminate in or be followed by gangrene of the mouth, are the pulmonary and intestinal inflammations, hooping cough, and the fevers, both eruptive and the non-eruptive. Rilliet and Barthez have published a table of ninety-eight cases in which gangrene resulted from various diseases. In forty-nine of these the antecedent disease was measles, in five scarlet fever, six hooping cough, nine intermittent fever, nine typhoid fever, seven mercurial salivation, and five enteritis. It is seen that the essential fevers were the most frequent cause of the gangrene. Of forty-six cases collected by MM. Bouley and Caillault, the antecedent disease was measles in all but five. In this city, also, a larger number result from measles than from any other disease.

One reason why so many cases of gangrene occur as a sequel of measles

is probably because this disease is accompanied by stomatitis. Simple or ulcerous stomatitis often precedes gangrene.

Diseases sometimes terminate in gangrene of the mouth in consequence of injudicious treatment, which has lowered the vitality of the system. Rilliet and Barthez mention the case of a child four years old, in whom gangrene commenced at the twenty-ninth day of primitive pneumonia. This child had been reduced by the application of twelve leeches, three scarifications, a large blister, and by the use of absolute diet.

The misuse of mercury was once a much more frequent cause of gangrene than at present, at least in this country, since this agent was formerly much more employed than now. In fact most of the affections of infancy and childhood in which mercurials were formerly employed are now treated without it.

Symptoms.—Gangrene of the mouth so often occurs in connection with other diseases, that its symptoms are in a large proportion of cases blended with those which arise from a distinct pathological state.

Fig. 35.

There is usually prostration more and more pronounced as the gangrene extends. The features are ordinarily pallid, but occasionally their normal color is preserved for a time; the expression of the face is melancholy, but composed. Sometimes the child is fretful, if disturbed; at other times it will quietly consent to an examination. The suffering is not proportionate to the gravity of the disease. There is less pain often than in some of the forms of stomatitis which are unattended with danger.

As the disease advances, the body and limbs gradually waste, the eyes are hollow, or, if the gangrene be near the orbit, the eyelids become œdematous, the lips are infiltrated, and both the lips and nostrils are

often incrusted. If the cheek be perforated, alimentation is rendered difficult, and the appearance of the child is melancholy in the extreme.

The tongue is usually moist; it is occasionally swollen. The saliva flows from the mouth, either pure or mixed with offensive sanguinolent matter. Unless the disease be slight, there is the peculiar gangrenous odor. The appetite is sometimes poor, at other times it is preserved through the whole sickness. There is no vomiting, or looseness of the bowels, unless from a complication. The thirst is usually great, and the pulse is accelerated and feeble, except in mild cases.

The skin in the commencement of gangrene is hot. When the vital force is much reduced, and especially as the disease approaches a fatal termination, the face and limbs become cool, and the surface generally presents a waxen or ashy appearance. No derangement occurs of the respiratory system. Those cases which are attended by a cough or accelerated respiration are really cases of bronchitis or pneumonia coexisting with the gangrene.

Diagnosis.—Gangrene of the mouth is easily diagnosticated. In those cases in which ulceration precedes the gangrene, it may be mistaken in its first stage for that form of ulcerous stomatitis in which the ulcers assume an unhealthy appearance. The following are the distinguishing features of the two affections: Around the ulcer where gangrene is about to commence the tissues are greatly thickened and indurated, or œdematous, while ulcerous stomatitis begins with a submucous deposit of fibrin, and is attended by little thickening of the surrounding parts, and little or no induration or œdema. In ulcerous stomatitis the skin over the seat of the disease presents its normal appearances, whereas in gangrene it presents a distended and shining appearance. The destructive process in ulcerous stomatitis is also more limited than in gangrene. Deep ulcerations do not occur, or are rare. Ulcerous stomatitis is more readily healed, and it leaves no eschar, contraction, or deformity.

The differential diagnosis of gangrene of the mouth from those cases of follicular stomatitis in which the ulcers occupying the seat of the follicles assume a gangrenous appearance, must be made by a consideration of the same facts or particulars which serve to distinguish it from ulcerous stomatitis.

Malignant pustule, of rare occurrence in the child, resembles this disease in some of its features. But the pustule always begins on the skin, while gangrene is a disease of the mucous surface primarily. In gangrene, therefore, the chief destruction is of the mucous membrane and of the submucous tissue, while in malignant pustule the chief destruction is of the skin and the subcutaneous tissue.

Prognosis.—This depends not only on the extent of the gangrene, but the nature of the disease, if there be one, which gave rise to it, and the degree of cachexia. If it occur in connection with or as a sequel of one of the less debilitating diseases, and there be considerable vigor of system, it may often be arrested when it has destroyed only the mucous and subcutaneous tissues, so that no deformity results. The friends may congratulate themselves if the case terminate so favorably. In the graver cases, when the gangrene extends until it destroys the periosteum of the maxillary bone on the affected side, and perhaps per-

forates the cheek, if the child recover it is with the permanent loss of teeth, tedious separation of the necrosed bone, and a cicatrix which may interfere with the free use of the jaw. Death is, however, the more common termination of severe cases. Occasionally the gangrene destroys the continuity of a bloodvessel, causing abundant hemorrhage, and accelerating the fatal result. In most cases, however, there is little or no hemorrhage, in consequence of coagulation in the vessels.

Another serious complication sometimes arises, to wit, gangrene of other parts, as of the external genital organs. The English editor of Bouchut's treatise on diseases of children relates the following interesting case, from the *Transactions of the Edin. Medico-Chir. Society:*

An infant eight months old became affected with gangrene of the face, head, and hands. "The right ear and the entire hairy scalp were of an intensely black color, and on both cheeks patches existed about the size of a half-crown piece. The right thumb and the backs of both hands were similarly affected. The child was noted to have been restless and feverish on May 22d, and on the 23d a slightly darkened ring was found to have formed round the thumb, about the middle of the first phalanx; in a few hours the whole thumb was gangrenous, and the dorsum of the hand became involved. On the ear the gangrene commenced with the appearance of a fleabite, and subsequently extended rapidly to the scalp, assuming a remarkably regular form, and giving to the child the appearance of wearing a black skull-cap. The pulse was observed to be very feeble. . . . Death took place in twelve hours from the first appearance of gangrene on the thumb, the child being sensible and continuing to suck well, up to a few minutes before death."

Rilliet and Barthez state that pneumonitis frequently occurs in the course of gangrene of the mouth. Such a complication evidently diminishes materially the chance of recovery.

Whether the result be favorable or unfavorable, it is evident, from the nature of the disease, that the duration is very different in different cases. The physician's attendance may be required for a week or two or for several weeks.

TREATMENT.—As gangrene of the mouth is eminently a disease of debility, all anti-hygienic influences should be removed, and the most nourishing diet, together with tonics, be recommended. The ferruginous preparations or the bitter vegetables are required.

As soon as the physician is called, he should endeavor to arrest the gangrene, accelerate detachment of the slough, and produce a healthy and granulating state of the surrounding tissues. This is best effected by applying a highly stimulating or even escharotic agent to the inflamed surface underneath and around the gangrene. For this purpose a great variety of substances have been used by different physicians, such as acetic, sulphuric, nitric, and hydrochloric acids, nitrate of silver, the acid nitrate of mercury, chloride of antimony, and even the actual cautery.

M. Taupin recommends, after removing a considerable part of the gangrenous substances with scissors or some instrument, the application of strong muriatic acid, and, when the slough is detached, of dry chloride of lime.

Rilliet and Barthez advised the use twice daily of muriatic acid or the acid nitrate of mercury, applied by a brush upon and around the slough, followed immediately by the application of dry chloride of lime, when the mouth is to be thoroughly washed with water from a syringe. They direct in the interval frequent ablution with water. After the slough has separated, the escharotic is to be discontinued, and the chloride of lime used alone. If gangrene extend to the skin, a crucial incision is to be made and the escharotic applied, after which powdered cinchona is introduced and retained by a plaster. This treatment is to be continued till the gangrene is arrested and the decayed portion removed. Barrier, Valleix, and most French writers, recommend essentially the same treatment, namely, the application of undiluted escharotic agents.

A safer, less painful, and in many cases successful treatment, is that employed by many British and American physicians, to wit, the use of escharotic agents diluted, or, if applied in their full strength, such as are least active and penetrating. Some employ from the first topical treatment which is astringent and stimulating rather than escharotic, and they report satisfactory results.

Dr. Gerhard believes "the best local applications are the nitrate of silver, if the slough be small in extent; if much larger, the best escharotic is the muriated tincture of iron, applied in the undiluted state. After the progress of the disease is arrested, the ulcer will improve rapidly under an astringent stimulant, such as the tincture of myrrh, or the aromatic wine of the French Pharmacopœia."

The local treatment recommended by Evanson and Maunsell differs from that advised by any of the writers from whom I have quoted. A knowledge of this treatment, from which I have myself seen good results, will be best imparted by quoting from these authors:[1] "The lotion which we have found by far the most successful is a solution of sulphate of copper as employed by Coates in the Children's Asylum. His formula is as follows:

℞.—Cupri sulph.	℥ij.
Pulv. cinchonæ	℥ss.
Aquæ	℥iv.—Misce.

"This is to be applied twice a day very carefully to the full extent of the ulcerations and excoriations. The addition of the cinchona is only useful by retaining the sulphate of copper longer in contact with the edges of the gums. A solution of the sulphate of zinc, ℥j to an ounce of water, by itself or combined with tincture of myrrh, Dr. Coates found to be also useful in some cases."

A moment's reflection will show us that the above treatment is preferable, provided that it is equally effectual in arresting the gangrene, to the treatment by the strong acids which are in common use, and the efficiency of which cannot be questioned.

The purpose in applying the acid is to establish a healthier state of the tissues. It cauterizes and destroys whatever soft tissue it comes in contact with, besides it produces a strong corrosive action on the teeth and bone. Therefore in gangrene affecting the jaw, there is great dan-

[1] Diseases of Children, 2d Amer. edit., page 188.

ger that it will destroy the periosteum, and consequently increase the necrosis.

Dr. West,[1] who advocates the use of the acid, says: "In one of the cases that I saw recover, the arrest of the disease appeared to be entirely owing to this agent, though the alveolar processes of the left side of the lower jaw, from the first molar tooth backward, died and exfoliated, apparently from having been destroyed by the acid." No such result follows the use of the solution of sulphate of copper.

In one of those severe cases in which the disease resulted from scarlet fever, and in which there was so much debility that an unfavorable prognosis was made, I succeeded in arresting the disease by the use of Dr. Coates's prescription. The child recovered with the loss of two teeth and the corresponding portion of the maxillary bone. From the good effects which I have observed from iodoform, as an application for gangrenous vulvitis following measles, it has occurred to me that it may also be useful in gangrene of the mouth.

If after employing the milder treatment for two or three days, the gangrene continue to spread, the strong muriatic acid should be cautiously applied by a camel-hair pencil or small swab, in such a way that it comes in contact only with the diseased surface. Its use should be immediately followed by an alkaline wash, as a solution of sodium bicarbonate.

In 1881, an epidemic of measles occurred in the New York Foundling Asylum during the attendance of Drs. O'Dwyer and Lee. The number of children affected with it was 165, and since many of them were cachectic, we were not surprised that gangrene appeared as a complication or sequel in seven cases. In a girl of $3\frac{1}{2}$ years, it appeared upon the upper jaw at the base of the teeth; in two girls of four years it appeared upon the inside of the cheek and upon the vulva, and not upon the gums; in a boy of three years it attacked the lower jaw, destroying four teeth with their sockets, and the upper jaw, destroying five teeth, with the corresponding portion of the maxillary bone, so that all the incisors and one canine were lost, as well as the cartilaginous portion of the nasal septum. Gangrene also occurred in the groin in this case. Another boy of $3\frac{1}{2}$ years lost two incisors from gangrene of the jaw. The treatment by muriatic acid was employed, and according to the house physician, Dr. Kortright, there was no further extension of the gangrene after the first application in any of the cases. All lived except the first, who had broncho-pneumonia. The remaining two patients, aged respectively four years, died of diphtheria and pneumonia before treatment could be tested. One of them had commencing gangrene of the lower jaw, the other of the soft palate. Recently, in the Foundling Asylum, carbolic acid has been used as an escharotic in one or two cases, instead of the strong acid, and with such a result as to encourage its further use.

The gases arising from the gangrenous mass are not only highly offensive to others, but they are doubtless injurious to the patient, who is constantly inhaling them. To remove the fetor, chlorine or carbolic

[1] Diseases of Children, 4th Amer. edit.

acid, properly diluted, should be occasionally used between the applications of the sulphate of copper. Labarraque's solution, one part to eight or ten parts of water, is an eligible form for its use. When the gangrene is removed, and the granulations present a healthy appearance, all danger is usually past and convalescence is fully established. Then no energetic topical treatment is required. A mild stimulating lotion, like the tincture of myrrh, as recommended by Dr. Gerhard, suffices, with the aid of tonics and nutritious diet.

CHAPTER IV.

DENTITION.

THE opinion formerly entertained in the profession, and now prevalent in the community, that many infantile maladies arise directly or indirectly from dentition, is erroneous. Still there are physicians of experience who believe that teething is a common cause of certain maladies, especially of functional derangements, even of organs remote from the mouth. On the other hand, equally good observers, and the number is increasing, almost wholly ignore the pathological results of dentition. They say that, as it is strictly a physiological process, it should, like other such processes, be excluded from the domain of pathology.

A moment's reflection will show how important it is to understand the exact relation of dentition to infantile diseases. Every physician is called now and then to cases of serious disease, inflammatory and non-inflammatory, which have been allowed to run on without treatment, in the belief that the symptoms were the result of dentition. I have known acute meningitis, pneumonitis, and entero-colitis, even with medical attendance, to be overlooked, and the symptoms attributed to teething during the very time when appropriate treatment was most urgently demanded. Many lives are lost from neglected entero-colitis, the friends believing the diarrhœa to be symptomatic of dentition, a relief to it, and therefore not to be treated. Such mistakes are traceable to the erroneous doctrine, once inculcated in the schools, and still held by many of the laity, that dentition is directly or indirectly a common cause of infantile diseases and derangements.

I shall endeavor to point out what is really ascertained in regard to the pathological relations of dentition.

The first dentition commences at the age of about six months and terminates at the age of two and a half years. The corresponding teeth of the two sides pierce the gum at about the same time. The two inferior central incisors first appear at about the age of six or seven months,

followed, in the order in which they are mentioned, by the upper central incisors, upper lateral incisors, lower lateral incisors, the four anterior molars, the four canines, and, lastly, the four posterior molars.

The incisors usually appear in rapid succession, so that all are in sight by the age of one year. From the age of one year to eighteen months the anterior molars appear, and from the age of sixteen to twenty-four months, the canines, and from twenty-four to thirty months the posterior molars. This order is not always preserved. Sometimes the upper central incisors appear before the lower, and sometimes the lower lateral before the upper lateral. In rare cases there have been teeth at birth. I have seen but one or two infants with such premature dentition. Retarded dentition is much more common. Those who have rickets, or are feeble either constitutionally or by disease, often have no teeth till considerably after the usual period. In such the first incisors may not appear till the age of twelve months, or even later.

Pathological Results of Dentition.—The evolution of the teeth is commonly attended by more or less turgescence around the dental bulbs. This is greater with some of the teeth than with others. Thus, the superior incisors cause more swelling than do their congeners of the inferior jaw. The turgescence, although attended by more or less congestion, is physiological within certain limits, and not a disease.

But sometimes there is an unusual amount of swelling around the dental follicles; the afflux of blood to them is greatly augmented; they are the seat of such a degree of tenderness and pain that the infant is fretful. It carries the finger often to the mouth, indicating the seat of its suffering. The surface over the follicles presents greater redness than in ordinary dentition, and the salivary secretion is considerably increased. There is now actual gingivitis.

Occasionally the inflammation affects a greater extent of the buccal surface than that lying directly over the follicles, so that most writers speak of stomatitis as one of the results of dentition. In a few cases I have known such a degree of inflammation over the advancing tooth, that a small abscess formed, producing much pain and restlessness, till it was opened by the lancet.

The pathological results of dentition which I have mentioned, though they may interfere more or less with nursing or feeding, are not dangerous. They are easily detected. They result directly from the rapid growth and augmented sensibility of the dental follicles.

There are other supposed accidents of dentition occurring in distant parts of the system in consequence of the relation and interdependence of organs which exist through the system of nerves.

Some children, previously to the eruption of the teeth, are affected with diarrhœa, occasionally accompanied by irritability of stomach. Certain writers have supposed that gastro-intestinal catarrh is present in these cases; others that there is simply a hypersecretion, an increased activity of the intestinal follicular apparatus, that it is, in other words, one of the forms of non-inflammatory diarrhœa. Barrier believes that the diarrhœa of dentition depends usually on what he calls a "subinflammatory turgescence limited to the gastro-intestinal follicular apparatus." He believes that, in occasional cases, it is due to defective or altered inner-

vation. It would then be analogous or similar to that form of diarrhœa which occurs in the adult from the emotions. Bouchut calls the diarrhœa of dentition nervous diarrhœa. It is certain, however, that in most cases of diarrhœa which are attributable to dentition, there are other causes, such as unsuitable food, or residence in an insalubrious locality. It is certain, as regards city infants, that the chief causes of diarrhœa during the period of dentition are strictly anti-hygienic, dentition being quite subordinate as a cause, and probably ordinarily not operating at all as such. But when, as sometimes happens, at each period of dental condition, the infant is affected with diarrhœa, the influence of teething is apparent. Such cases enable us to see that teething may really sustain a causative relation to certain diseases not located in the buccal cavity.

Among the more common pathological results of difficult dentition, are certain affections referable to the cerebro-spinal system. Eclampsia is one of the admitted results. Barrier attributes convulsions in the teething infant to excitement of the nervous system arising from the pain which is felt in the gums, and to a determination of blood to the dental apparatus, in which afflux the whole vascular system of the head participates.

In most cases of convulsions occurring during the period of dental evolution, a careful examination discloses other causes in addition to the state of the gums. Difficult dentition must then be considered, not so frequently a direct as a coöperating or predisposing cause, producing a sensitive state of the nervous system, or possibly an afflux of blood to the head, of which Barrier speaks, and which, by an additional stimulus, perhaps trivial in itself, ends in convulsions. In exceptional instances eclampsia occurs mainly from dentition, or, if there are other causes, they are quite subordinate. This may happen when several teeth penetrate the gum at or about the same time. Infants who are burned or scalded are very liable to clonic convulsions. This is, in fact, the chief danger as regards life from such accidents. So, the swollen and tender gum, if several teeth are about emerging, may affect the cerebro-spinal system like the burn or scald, and produce the same nervous phenomena. Thus, in a case already alluded to in the chapter on convulsions, five incisors pierced the gum within about two weeks, and in this period there were two attacks of eclampsia with an interval of a few days. The attacks were not severe, and the most careful examination could discover no other cause than the simultaneous development of so many dental follicles. Previously, and since, the infant has been well.

Dentition, sometimes, though rarely, occasions also tonic convulsions. The following case occurred in the practice of the late Dr. A. S. Church, of this city, the history of which he communicated, as follows:

Case.—"H., seven months old, was first visited April 3, 1863. The patient had been fretful for several days, but about daylight on the morning of my first visit it commenced crying, and had not ceased for a moment at the time of my visit, 9 A. M. The bowels were somewhat constipated and tympanitic; abdominal muscles very tense. The pain was supposed to be in the abdomen, and a brisk cathartic, to be followed by an anodyne, was ordered. Some relief followed, but, on the ensuing and for

several consecutive mornings, the pain returned, each day lasting longer, until the child only ceased crying while under the influence of a full anodyne. The gum over the upper incisors was considerably swollen, hot, and dry, but the parents would not consent to have it scarified. For the first week there was no fever, no vomiting, and not the least indication that the nervous system was suffering. About the 10th the thumbs were noticed to be flexed during the attack of pain, and about the 15th the flexors of the toes were contracted and the hands were turned backward and outward, but only while the child was awake. About the 20th there was constant contraction of the flexors of both extremities, with opisthotonos, and constant rolling of the head, loss of appetite, progressive emaciation, coated tongue, and highly inflamed gums. Consent was, finally, obtained to relieve the inflamed gum, and free incisions were made, and the following night the child slept comfortably for three hours without opiates. In three days the gums were freely cut again, and the teeth soon made their appearance. All symptoms of disease had now ceased, the child became playful, and on 30th the patient was discharged."

The opinion has been prevalent in the profession, that painful and difficult dentition is one of the chief causes of infantile paralysis, but it is now commonly admitted that it is only a subordinate or remote cause, if indeed it is proper to consider it as a cause at all. (See Art. Paralysis.)

Some writers express the opinion that acute meningitis occasionally results from teething. The facts, however, that are relied upon to prove this are uncertain. The occurrence of meningitis during dentition is probably in most instances a coincidence.

Teething less frequently disturbs the respiratory system than either the digestive or cerebro-spinal. A cough occurs in some infants at each period of dental evolution. It is attended by little expectoration, but appears to be associated with, in at least certain cases, an inflammatory turgescence of the bronchial mucous membrane.

Acceleration of pulse is often observed at the time of greatest swelling and tenderness of the gum. It subsides with the protrusion of the tooth. The febrile movement of dentition is irregular, sometimes presenting a remittent form, like remittent fever or the fever premonitory of meningitis. Eczema and certain other cutaneous diseases are common during dentition, but their dependence on it as a cause has not been demonstrated.

Diagnosis.—The accidents of dentition which are located in the mouth are easily diagnosticated, except the odontalgia which writers describe, and which is not necessarily attended by any perceptible anatomical alteration of the gums. Those accidents which pertain to remote and concealed organs are usually detected with ease, though it is often difficult to determine with certainty their relation to dentition.

When similar symptoms arise at each epoch of teething, and subside with the subsidence of the gingival turgescence, teething must be regarded as the cause. Or, if the disease be such as is known to be produced occasionally by difficult teething, and if, after a careful examination, we can discover no other cause, while the gums are swollen, especially over two or more advancing teeth, it is proper to refer the malady to dentition.

It is evident that we must often be in doubt whether the disease we are treating be due at all to the state of the gums, or, if so, whether directly or indirectly, or to what extent; but, as a rule, if any other cause be apparent, we may properly regard the influence of dentition as quite subordinate.

Treatment.—It is obvious that remedial measures in cases of difficult dentition must be twofold, namely, those directed to the state of the gums, and those designed to relieve the derangements or diseases to which dentition has given rise. If there be diarrhœa, this should be controlled by proper remedies, so as to reduce the number of evacuations to two or three daily. It is well to state to the friends of the child, who believe that diarrhœa is salutary during the period of teething, that this number is quite sufficient, and that more frequent evacuations endanger the safety of the child.

The nervous affections, as convulsions, require such soothing and derivative measures as are recommended in our remarks on diseases of the nervous system. The bromide of potassium I have found especially useful and safe in cases of fretfulness and nervous excitement due to dentition. Demulcent and soothing lotions are sometimes useful in cases of painful dentition, and the infant may be allowed to hold in its mouth an India-rubber or ivory ring, which seems to give considerable relief.

Mothers often attempt to "rub through a tooth," as they term it, by means of a ring or thimble. This should be discouraged. So great friction cannot fail to have an injurious effect, by increasing the swelling and inflammation, unless the tooth have already reached the mucous membrane.

We come now to a subject which has engaged the attention of many physicians of ample experience, and in reference to which there is still a difference of opinion among the highest authorities in medicine. I refer to scarification of the gums.

The gum-lancet is much less frequently employed than formerly. It is used more by the ignorant practitioner, who is deficient in the ability to diagnosticate obscure diseases, than by one of intelligence, who can discern more clearly the true pathological state. Its use is more frequent in some countries, as England, under the teaching of great names, than in others, as France, where the highest authorities, as Rilliet and Barthez, discountenance it.

It is well to bear in mind, as aiding in the elucidation of this subject, the remark made by Trousseau, that the tooth is not released by lancing the gum over the advancing crown. The gum is not rendered tense by pressure of the tooth, as many seem to think, for, if so, the incision would not remain linear, and the edges of the wound would not unite, as they ordinarily do, by first intention within a day or two. This speedy healing of the incision, unless the tooth be on the point of protruding, is an important fact, for it shows that the effect of the scarification can last only one or two days. The early repair of the dental follicle is probably conservative, so far as the development of the tooth is concerned. It may help us to understand how active, how powerful, the process of absorption is, if we reflect that the roots of the deciduous

teeth are more or less absorbed by the advancing second set, without much pain or suffering from the pressure. If the calcareous particles of the teeth are so readily absorbed, what is the foundation for the belief that the fleshy substance of the gum is absorbed with such difficulty? Too much importance has evidently been attached to the supposed tension and resistance of the gum in the process of dentition.

Follicles in the period of development are especially liable to inflammation. We see this in the follicular stomatitis and enteritis so common when the buccal and intestinal follicles are in a state of most rapid growth. Does not this law in reference to the follicles hold true of those by which the teeth are formed, so that the period of their enlargement and greatest activity, which corresponds with the growth and protrusion of the teeth, is also the period when they are most liable to congestion and inflammation? It seems probable that the dental follicles are most liable to become inflamed, and therefore tender, from various causes apart from dentition, at the time of their greatest functional activity.

If there be no symptoms except such as occur directly from the swelling and congestion of the gum, the lancet should seldom be used. The pathological state of the gum which would, without doubt, require its use, is an abscess over the tooth. As to the symptoms, which are general or referable to other organs, as fever and diarrhœa, the lancet should not be used if the symptoms can be controlled by other safe measures. All coöperating causes should first be removed, when in a large proportion of cases the patient will experience such relief that scarification can be deferred.

If the state of the infant be one of immediate danger, as in eclampsia, and it be not quickly relieved by the ordinary remedies, scarification may not only be proper but required to insure safety. For in such cases all measures, provided that they are safe and simple, which can possibly give relief, should be employed without delay. But I can recall to mind only two accidents of dentition which would be likely to be benefited by scarification, namely, suppurative inflammation in the dental follicle and convulsions. But since the bromide of potassium and hydrate of chloral have come into use as nervous sedatives, and as efficient remedies for clonic convulsions, scarification of the gums is much less frequently required, for even severe eclampsia commonly yields to these medicines, if the condition of the bowels be attended to.

Second Dentition.

The fact is well established, though often overlooked in practice, that second dentition occasionally deranges the functions of organs, and gives rise to pathological symptoms. Rilliet and Barthez mention particularly neuralgic pains, rebellious cough, and diarrhœa, as effects which they have observed. Rilliet relates the case of a girl, eleven years old, who had a very obstinate and protracted cough, the paroxysms lasting often half an hour to one hour. This cough immediately and permanently disappeared when the molars pierced the gums.

Dr. James Jackson[1] says: "I have seen persons between twenty and thirty years of age much affected by a *wisdom tooth* not yet protruded, and distinctly relieved by cutting the gum. But I think the most common period of suffering from the second dentition is from the tenth to the thirteenth year. The most characteristic affections are wasting of flesh and nervous diseases. The boy loses his comeliness, and his complexion is less clear, while emaciation takes place in every part, though mostly, perhaps, in the face. The nervous symptoms are various, but the most common are a change in the temper and a loss of spirits. With these there is some loss of strength. The patient is unwilling to engage in play, and soon becomes tired when he does do it. Among the distinct symptoms which are not uncommon, I may mention pain in the head and in the eyes. The headache is not commonly severe, but it is such as inclines the patient to keep still. The eyes are not only painful, but are often affected with the morbid sensibility to which these organs are subject. I have known boys truly anxious to pursue their studies obliged to give them up on this account; and these, not having the disposition to play, will of choice pass the day with their mothers, and increase their troubles for the want of air and exercise. Nervous affections of a more severe character are sometimes manifested."

Whether the symptoms which have been attributed to second dentition have always been due to this cause, is questionable. Practically, however, it matters little whether we recognize dentition as the cause, or assign something else. Hygienic and medicinal measures to improve the general health will usually suffice to relieve the patient. Elsewhere I have related the case of a boy, of nervous temperament, about seven years old, who recovered immediately from a cough which had lasted for several weeks, by taking a mixture of iron and nitric acid. Many do well without medicine, simply by hygienic measures. Dr. Jackson says: "The remedies which I have found most useful are as follows: First, a relief from study or from regular tasks, yet using books so far as they afford agreeable occupation or amusement. Second, exercise in the open air, preferring the mode most agreeable to the patient, and in more grave cases the removal from town to country."

[1] Letters to a Young Physician.

CHAPTER V.

CATARRHAL PHARYNGITIS, PERI-PHARYNGEAL ABSCESS, ŒSOPHAGITIS.

CHILDREN of all ages are liable to inflammation of the pharynx. In its mildest form it often, doubtless, escapes detection in the young infant. In older patients it is revealed by pain in swallowing solid food, and more or less tumefaction below the ears, apparent to the sight. It is said to be less frequent in infancy than in childhood. In the adult, and in children over the age of four or five years, inflammation of the pharyngeal surface is often confined to the portion of membrane which covers or immediately surrounds the tonsils. It occurs in connection with inflammation of these glands. But in infancy and early childhood this limitation is comparatively rare. Catarrhal inflammation of the fauces at this age is ordinarily general, the tonsils participating in the morbid state.

Pharyngitis is primary or secondary. The secondary form occurs in measles, scarlet fever, bronchitis, croup, pneumonitis, and occasionally in other affections. As these diseases are common, physicians are oftener called to treat patients who have the secondary form than the primary. Rilliet and Barthez met eighty-three secondary to sixteen primary cases.

ANATOMICAL CHARACTERS.—The pathological anatomy of pharyngitis is ascertained by depressing the tongue and inspecting the fauces. The faucial surface is seen to be redder than in health, with more or less swelling, according to the intensity of the inflammation. In the primary inflammation the color is commonly bright red, almost like that of arterial blood. If, on the other hand, the inflammation occur in connection with a constitutional malady, the hue is often darker. In grave cases of scarlet fever or measles it is sometimes even livid, indicating a vitiated state of the blood, a condition of real danger. The tonsils are tumefied so as to project, though not to the extent which we observe in the adult. They are then less firm than in the normal state. The follicles of the throat are enlarged and active, pouring out a muco-purulent secretion. This is sometimes seen in a layer over the tonsil or the posterior portion of the fauces. In a case of primary pharyngitis examined after death by Rilliet and Barthez, the tonsils were softened, infiltrated with pus, and slightly enlarged. A layer of bloody mucus lay on the pharyngeal surface, which was dark red, thickened, and glandular. The submaxillary glands were also swollen and somewhat softened.

If the inflammation be intense, the deep-seated portions of the tonsils become involved, and even sometimes the adjacent connective tissue. In such cases, by applying the fingers in the hollows below the ears, the tonsils can be felt.

Causes.—The usual cause of primary pharyngitis is exposure to cold. It also occasionally occurs from the use of drinks too hot or containing some irritating substance. I have met it in the most intense form caused by swallowing boiling water, and, in one case, from acetic acid taken through mistake. When it occurs in the eruptive fevers, it is usually part of a more extensive phlegmasia, in which the buccal and perhaps laryngeal and nasal surfaces participate.

Symptoms.—Fever, with thirst and loss of appetite, is common, and is usually proportionate, in intensity, to the extent and severity of the inflammation. At first there is dryness of the faucial surface, and this is succeeded by a more or less abundant viscid secretion. Swallowing is painful, except in mild cases. The muscles of the anterior half arches, which by their contraction close the opening from the pharyngeal to the buccal cavity, and those of the posterior arches, which close the opening to the nasal cavity, both which sets lie a little under the mucous membrane, are often so infiltrated with serum that their contractile power is diminished, and if the same happen with the constrictor muscles, which carry downward the food, swallowing becomes difficult, and in the attempt more or less of the ingesta is liable to return into the mouth, or enter the nostril. During health the air passes through the nostrils in the pronunciation of two letters only, namely, N and M, but in severe pharyngitis, in consequence of the swelling, and the impairment of the action of the muscles concerned in speech, the air passes through the nostrils with the utterance of many words, producing the nasal tone of voice. Sometimes the inflammation traverses the Eustachian tube to the middle ear, causing earache, which may be relieved by the escape of pus down the tube, or by perforation of the drum into the external ear.

The breath is foul, but not fetid; the respiration normal, or but slightly accelerated; there is commonly no cough, but it is sometimes present, due to the extension of the inflammation to the upper part of the larynx, or to the collection of mucus around the aperture of the glottis. In most cases of pharyngitis a light fur covers the tongue, and stomatitis of a mild grade is present, as shown by redness of the buccal surface, and increased mucous secretion.

Chronic pharyngitis, which is so common in adults, and which is produced in some by gastric derangements, and in others by excessive smoking, or the prolonged use of intoxicating drinks, and in others, still, by the syphilitic or mercurial cachexia, is comparatively rare in children.

Prognosis.—In mild cases of pharyngitis convalescence commences within a week. If the inflammation be dependent on a constitutional malady it may continue considerably longer, especially if the glands of the neck, and the connective tissue, be much involved. The prognosis in secondary pharyngitis is less favorable than in that of the primary form. In fatal cases there is usually a vitiated state of the blood, either from the coexisting constitutional disease, or from previous cachexia.

Pharyngitis may, however, become dangerous from complications to which it gives rise. The proximity of the inflammation to the brain, or its effect upon the cerebro-spinal axis through the medium of the nerves, sometimes gives rise to clonic convulsions. In a recent case of primary

pharyngitis in my practice, repeated and violent convulsions occurred in an infant, about one year old, from this cause. They commenced at the inception of the inflammation, and constituted the only real danger. Pharyngitis may interfere materially with nutrition in consequence of the dysphagia, but in most cases of primary pharyngitis this symptom does not continue sufficiently long to endanger the life of the patient. In grave constitutional affections, as scarlet fever, the difficulty of swallowing, and the consequent innutrition, augment the danger. As regards, therefore, the prognosis in catarrhal pharyngitis, whether primary or secondary, it may be stated as a rule, that it is not, *per se*, a fatal disease, but is only so from complications, or from aggravating the primary malady with which it is associated.

DIAGNOSIS.—This is not difficult provided that attention be directed to the throat; but the physician often fails to discover it at his first visit, from neglecting to examine this part. In many cases the local symptoms are not well marked, and in the absence of these the febrile reaction may at first be referred to some other cause than the true one. Inspection not only reveals the presence of inflammation, but enables us to determine whether it be simple pharyngitis, or diphtheritic or ulcerative. In some instances, simple pharyngitis resembles the diphtheritic, from the presence of confervoid growths upon the inflamed surface, usually the leptothrix buccalis. The differential diagnosis is based on the easy removal and soft pultaceous character of the confervæ, and the appearance under the microscope.

TREATMENT.—*Mild* cases of simple pharyngitis require little treatment. With moderate counter-irritation over the throat, and the use of laxative medicines, the inflammation soon subsides. The oleum camphoratum may be occasionally rubbed over the throat, and retained upon it by flannel. The effect is increased by the application, once or twice daily, of mustard or tincture of iodine, or by adding to the liniment one-fourth or one-third of its quantity of turpentine.

Some children seem to be most relieved by a muslin compress frequently wrung out of cool water, or a light India-rubber bag containing ice. Frequently rubbing the neck with warm oil or camphorated oil, and binding upon it a rind of salt bacon, are popular modes of treatment, and no doubt are productive of benefit.

In the severe forms of this inflammation, occurring independently of any other disease, more acute measures are sometimes required.

If there be stupor or restlessness, with unusual heat of head, and starting or twitching of the limbs which threaten convulsions, two to five grains of the bromide of potassium given every two or three hours produce a calmative effect.

Diaphoretics and sometimes cardiac sedatives are also indicated, such as liquor ammoniæ acetatis, spiritus ætheris nitrosi, ipecacuanha, and aconite. Medicines of this kind may be variously combined according to the age and condition of the patient, and the severity of the disease.

As the symptoms abate, the intervals between the doses may be increased.

In cases attended by much tenderness and dysphagia great relief is often obtained by hot poultices frequently applied over the neck.

Topical treatment of the pharynx is recommended by most authors. Rilliet and Barthez use for this purpose nitrate of silver or powdered alum. The former has been most employed by physicians. It may be applied in the proportion of ten grains to the ounce two or three times daily. I prefer the following mixture, used with the hand atomizer every two or four hours:

℞.—Acid. carbolic. . . . . ℥ss.
Potas. chlorat. . . . . ℥iij.
Glycerinæ . . . . . ℥iij.
Aquæ . . . . . ℥vj.—Misce.

This can of course be used as a gargle by those old enough, or more continuously by the steam atomizer.

The treatment of secondary pharyngitis will be described in connection with the treatment of the diseases which it complicates. Suffice it here to say that this form of inflammation must not be treated by those depressing remedies which may be useful in cases of idiopathic pharyngitis.

Peri-Pharyngeal Abscess.

Every practitioner should bear in mind the fact that an abscess occasionally forms between the pharynx and vertebral column (retro-pharyngeal), or upon the side of the pharynx in the submucous connective tissue. This constitutes a disease which is likely to be fatal, but which can ordinarily be promptly relieved by the surgeon.

Yet, if we look over the records of peri-pharyngeal abscess, we shall see that in a large proportion of fatal cases the disease was supposed to be something else, and so treated until its nature was revealed by post-mortem examination. The most complete monograph on this malady with which I am acquainted was published by Dr. Allen,[1] of this city, under the title of retro-pharyngeal abscess. To this paper I am largely indebted for the facts contained in this article

Age—Cause.—This abscess may occur at any age, but it is most common in infancy and childhood. It is more frequent in the first two years of life than at any other period. Of the cases collated by Dr. Allen, in which the age is stated, twenty were under ten years, and twenty-one over this age. The abscess occurs in some patients from caries of the vertebral column, and, in others, from inflammation developed in the connective tissue or small lymphatic glands lying immediately outside the pharynx, or from a catarrhal pharyngitis. Whichever the cause, there is usually a scrofulous or reduced state of system.

Writers describe two kinds of peri-pharyngeal abscess, the primary and secondary. This distinction is based on the fact, whether or not the inflammation which leads to the abscess be dependent on an antecedent pathological state.

In the primary form the cause is usually atmospheric, or it is some irritating substance which has been swallowed, and which, lodging in the pharynx, produces phlegmonous pharyngitis.

[1] N. Y. Jour. of Med. for November, 1851.

The cause is mentioned in twenty cases of the primary form, collated by Dr. Allen, as follows: exposure to cold, ten cases; lodgement of bone in pharynx, eight cases; blow with a fencing-foil, one case. In the last case the button of a fencing-foil passed through the right nostril into the pharynx.

The secondary form occasionally occurs after measles and scarlet fever. The inflammation of the pharynx, common in those diseases, extends to the subjacent connective tissue, and, aided by the dyscrasia of the patient, becomes suppurative. Such cases have been observed by Rilliet and Barthez. The most common cause of the secondary form is, however, caries occurring in the cervical vertebræ.

When thus occurring it is similar, both as regards cause and nature, to lumbar abscess. It would follow the same chronic course, and would properly be described in connection with it, were it not for its proximity to the air-passages, which renders the symptoms so urgent and dangerous. In a few recorded cases the abscess was a sequel of erysipelas. In nineteen cases of secondary abscess, in Dr. Allen's collection, the cause is assigned as follows: erysipelas of face, two; inflammation following a fall upon the inferior maxilla, one; after cerebritis, one; syphilis, four; caries of the cervical vertebræ, six; scrofula, five.

The plausible opinion is expressed by Mr. Fleming,[1] that the suppuration begins, in a large proportion of cases, in the small lymphatic glands which lie in the connective tissue external to the pharynx. The late Prof. Geo. T. Elliot[2] has recorded the case of an infant of seven months, in whom peri-pharyngeal abscess immediately followed, and was apparently due to parotiditis.

In rare instances the abscess, or the local disease which leads to it, appears to exist from birth. Thus Dr. E. O. Hocken relates[3] the history of an infant who died at the age of nine weeks. It had always, when taking the breast, thrown back its head as if nearly suffocated. The walls of the abscess were thick and firm, described by the writer as cartilaginous. Occasionally there is no apparent cause of the abscess, except the strumous or cachectic state.

Anatomical Characters.—The seat of the abscess is not the same in all cases. The swelling can ordinarily be seen on examining the fauces, but occasionally it is so low as to be really peri-œsophageal, and, therefore, invisible. The size of the abscess varies; sometimes it is large, pressing inward the wall of the pharynx even against the velum palati and into the posterior nares, if the abscess have a high location, or, if lower, against the larynx, so as to embarrass respiration. Sometimes the abscess is so large, or has such lateral extension, that there is external swelling along the side of the neck. In a few cases on record the pus, instead of being discharged into the pharynx, made its way down the neck between the muscles and the connective tissue to the pleural cavity, which it entered, producing fatal pleuritis.

The walls of the abscess have been found in a different state in different cases. Sometimes the sac, at the projecting point, is so thin that it

[1] Dublin Journ. of Med. Sci., vol. xviii.
[2] Obstet. Clinic, N. Y., Appleton & Co., 1868.
[3] Prov. Med. and Surg. Journ., 1842.

seems as if there might have been a spontaneous cure, could life have been preserved a few hours longer. In other cases the sac is so thick and firm that its rupture, for many days, would be impossible.

Symptoms.—The percursory symptoms differ in different cases, according to the nature of the cause, whether it be phlegmonous pharyngitis or simply adenitis or vertebral caries. If the abscess proceed from caries, it is preceded by deep-seated pain, greatly increased by movements of the head, and probably preceded also by induration along the sides of the vertebræ.

The patient with this disease is restless, his mouth hot and dry; tongue furred; deglutition more or less difficult. Sometimes after suppuration has occurred there are alternations of rigors and fever. The symptoms indicate approximately the seat of the inflammation, but on examination we do not find that degree of redness of the mucous surface which we had been led to expect. The tissues which are chiefly involved in the inflammation, being submucous, are hidden from view. We observe redness of the pharynx, but it is disproportionate to the intensity of the symptoms. Some patients frequently experience a chilly sensation through the entire period of the abscess, though greater at one time than at another, and occasionally convulsions occur, especially in young infants. In ordinary cases embarrassment of respiration begins early, and is the cause of the chief danger. It becomes more and more marked as the abscess increases. It is noticed both during inspiration and expiration. The dysphagia also increases, sometimes to such a degree that drinks are taken with difficulty, and solid food refused. The respiratory symptoms bear considerable resemblance to those in protracted laryngitis, for which this disease has been mistaken. While the respiration becomes impeded or whistling, the voice is also feeble or indistinct, from the pressure of the tumor.

But the symptoms described above are not all present in every case. They vary according to the size and location of the abscess, whether it be high or low, posterior or lateral. I have met the disease in a child old enough to make known the subjective symptoms, in whom there was little or no dysphagia, and others report similar cases. When the tumor has attained such a size as to produce well-marked symptoms and jeopardize the life of the patient, it, or a part of it, can ordinarily be seen on depressing the tongue, but usually its location and condition can be better ascertained by exploration with the finger. The dyspnœa increases as the abscess enlarges, and, after a time, unless it burst spontaneously or be opened by the surgeon, imperfect oxygenation of the blood results. In some patients paroxysms of dyspnœa occur, so as to threaten immediate suffocation; coughing or attempts to swallow induce these paroxysms, and the patient is forced to remain in an erect or semi-erect posture; the tongue is protruded, the head thrown back, the pulse is frequent and rapid, the limbs become livid and cool, and finally death results from dyspnœa. Occasionally, when death seems inevitable, the abscess breaks during the struggles of the child, and the patient is restored to health. In rare cases the result is different. The trachea and bronchial tubes are deluged by the purulent discharge, and immediate suffocation occurs. The following was an example: In May, 1871,

a boy two years and five months old was brought to the class at Bellevue, who had the symptoms of an abscess for three months. The head was carried on one side, its rotation caused pain, and a laryngeal râle accompanied respiration. The upper part of the tumor could be detected by the finger; but, on account of its low location, it was impossible to open it with the bistoury. The temperature was 103°, pulse 156. The case was kept under observation, but in a few days the dyspnœa suddenly became so urgent that death was imminent, when the attending physician of the class, Dr. Swezey, broke the abscess with his finger, and pus was ejected on the floor; death, however, occurred almost immediately.

A correct appreciation of the symptoms and nature of peri-pharyngeal abscess will be best obtained by relating a case. I select the following from the *Trans. of the Lond. Pathol. Soc.*, Oct. 20, 1846:

A female infant died at the age of seven months, having had difficult breathing three weeks, and extreme dyspnœa during the last days of life. The dyspnœa was constant, and was aggravated by mental excitement, by movements of the body, and by exposure to cold. During the paroxysms a peculiar, croupy sound accompanied inspiration. There was no dysphagia through the entire sickness, and death occurred from apnœa.

The sac of the abscess was of the size of a pigeon's egg, and was situated between the upper cervical vertebræ and the back of the pharynx. The abscess was flattened in front, so as not to cause any decided prominence of the wall of the pharynx. From the sac a second small cyst extended forward, forming a nipple-like swelling in the pharynx, which completely closed the orifice of the glottis. Its aperture of communication with the body of the abscess admitted the point of the little finger, and the whole swelling was freely movable and perfectly translucent at its extremities and sides. The abscess might have been easily punctured, with probably the preservation of life.

The *duration* of this malady is very different, according to the severity of the inflammation, the rapidity with which the abscess enlarges, and the direction which it points. A lateral or downward extension is not so immediately dangerous to life as the anterior.

The time when the abscess begins to form cannot be precisely ascertained, and most writers, in determining its duration, compute from the first appearance of symptoms which are referable to the pharynx. Dr. J. Byrne[1] relates a fatal case in which the disease had apparently continued only about one week. The patient was an infant one year old, and its death was from apnœa. The abscess was large, extending from the base of the skull to the thorax, and pressing both on the larynx and trachea. M. Besserer[2] gives the history of an infant four months old, who died in the same way after thirteen days. An infant nine months old, whose case was published by Dr. W. C. Worthington,[3] lived nine days. The abscess occurred from exposure to cold; the patient was treated for croup, and died from suffocation. The anterior wall of the abscess was very thin. Since the first edition of this book was published,

[1] Amer. Journ. of Med. Sci., 1838.
[2] Archiv Gēn de Méd., 1840.
[3] Prov. Med. and Surg. Journ., 1842.

I have met six patients with this disease in whom the pus was evacuated when the dyspnœa had become urgent. In two the symptoms indicated a continuance of the disease from two to four weeks, and in the third case four months. The fourth case is interesting on account of the short duration of the severe symptoms. The following is the record of it: M. E., aged 7 months, female, nursing, inmate of the New York Foundling Asylum, was observed to have difficult breathing for the first time, on March 28, 1875. Since about March 8, some swelling had been noticed along the side of the neck, but it gave rise to no marked symptoms and she had not seemed ill, till the obstruction in the respiration commenced. At my visit on the evening of the 28th, the infant was pointed out to me as in a dying condition. She was lying in a state of stupor, pallid, and gasping for breath, with a temperature of 103°, and very feeble pulse, numbering about 200 per minute. On carrying the finger into the throat an abscess could be readily detected, situated in the walls of the pharynx on the left side posteriorly. This was easily opened by a curved bistoury, around which adhesive plaster was wound to within half an inch of the point. The breathing immediately began to improve. On the following day the infant was playing in the mother's lap, with a pulse of 140, but a normal temperature. With the use of cod-liver oil and the syrup of the iodide of iron, its health was soon fully restored. In the fifth case the abscess ruptured by the finger, and in the sixth it was opened by the lancet. All these patients recovered.

When the abscess grows slowly, and presses lightly on the air-passages, the case may continue for months. Such a one was observed by the late Professor Willard Parker. (Allin.) This infant was one year old; it suffered from pharyngeal symptoms nine months, was treated for tonsillitis, and death occurred as usual from apnœa. The abscess was two inches long, and there was no disease of the vertebræ. The same surgeon saved the life of another patient four years old, in whom the disease was protracted, by puncturing the abscess; and Professor Post, of this city, also treated successfully a case which had continued three months. (Allin.)

Diagnosis.—The diagnosis of retro-pharyngeal abscess is ordinarily easy, provided that the physician examine carefully and bear in mind the occasional occurrence of such an abscess. In a large proportion, however, of the recorded fatal cases, the true nature of the disease was not recognized during life. Especially is the diagnosis difficult when the cerebro-spinal system is early implicated, and symptoms arise which divert attention from the throat to the brain.

The maladies for which peri-pharyngeal abscess is most frequently mistaken are laryngitis and simple but severe pharyngitis. From laryngitis, for which it has been most frequently mistaken, it may be distinguished by the dysphagia and by the character of the initial symptoms. In laryngitis there is usually the peculiar cough from the first or very early, while in abscess there is an initial period of several days or even weeks before respiration is materially affected. This is the period of inflammation which precedes suppuration.

In abscess pressure of the larynx backward is badly tolerated, greatly

increasing the dyspnœa, while in pharyngitis and croup this effect is not so marked. In abscess the horizontal position aggravates the dyspnœa, but not in pharyngitis and croup. The character of the voice also aids in diagnosticating an abscess from laryngitis, since in the former it is usually nasal, and in the latter hoarse and whispering. But the decisive test is afforded by inspection and digital exploration. The tumor is seen, or, if situated too low to be seen, is felt, upon the walls of the pharynx.

If the symptoms of abscess are masked by those arising from the cerebro-spinal system, as by convulsions, the priority of the pharyngeal symptoms aids in determining the true disease.

In a case of suspected abscess the physician should not only carefully inspect the fauces, but should also employ digital examination. The finger will often detect fluctuation before the abscess is apparent to the eye.

Prognosis.—With proper treatment the result is usually favorable, but, if the disease be not recognized, many die. In Dr. Allin's cases, of those under the age of twelve years nine died, while ten recovered by the opening of the abscess by the lancet, trocar, or finger, and one by its spontaneous rupture.

If the abscess be due to disease of the spinal column, death may occur immediately after the sac is opened, the caries of the intervertebral cartilages producing, according to Dr. Allin, dislocation of the vertebræ. Death may also occur, though rarely, from pleuritis, in consequence of the bursting of the abscess into the pleural cavity. Even in caries, if the sac be properly opened, and if need be reopened, and the head supported by suitable apparatus, recovery is possible, as in a case treated by Prof. Post.

Treatment.—The proper treatment of peri-pharyngeal abscess is simple, consisting in breaking or puncturing the sac by the finger, the lancet, bistoury, or pharyngotome. Each method has been successfully employed. In the majority of cases the proper way to open the abscess is by the ordinary curved scalpel or bistoury, which should be covered by a strip of adhesive plaster to within a half inch of the point. If the abscess be post-pharyngeal, it should be opened in the median line. A single incision suffices to evacuate the pus. If the abscess point or be elastic, there is little danger of wounding any important vessel, or producing dangerous hemorrhage if the operation be properly performed. It may be necessary to open the abscess more than once, as in a case reported by Dr. Post, and another which I saw with Dr. Livingston, of this city. In certain cases, when the knife cannot be readily employed, the abscess may be opened by pressure with the finger-nail or the edge of a teaspoon.

Patients with this disease ordinarily require constitutional treatment, especially the use of tonics, ferruginous and vegetable. The citrate of iron and quinine, the citrate of iron and ammonium, and in strumous cases the syrup of the iodide of iron with cod-liver oil, are eligible preparations. Nutritious diet and often alcoholic stimulants are required.

Œsophagitis.

Disease of the œsophagus in infancy and childhood is comparatively rare, inflammation being the most frequent affection of this portion of the digestive tube in these periods, and, indeed, the only one which claims attention. It is most common in infants under the age of three or four months, who are deprived of the breast-milk, and are given a diet which is with difficulty digested, and perhaps taken too hot or too cold. It is, therefore, most common in foundling hospitals. I have frequently observed it in the Infant's Hospital, and the Nursery and Child's Hospital, of this city, chiefly at the autopsies of bottle-fed infants under the age of six months, whose symptoms had indicated disease or derangement of the digestive function. Many of them had diarrhœa, and died in a state of emaciation. Œsophagitis in these cases was associated with simple or gangrenous stomatitis, thrush, or with gastritis or entero-colitis. Sometimes all these inflammations coexisted. In a few cases the confervoid growth of thrush had extended from the mouth to the œsophagus. It occurred in small hemispherical masses, scarcely as large as a pin's head. Swallowing corrosive or strongly irritating substances, as the acids or alkalies, is an occasional cause of œsophagitis, the irritant at the same time producing stomatitis and gastritis.

Anatomical Characters.—The inflamed surface sometimes presents a uniformly injected appearance. Usually, however, there is greater intensity of the inflammation in streaks or patches than over the surface generally. I have frequently observed at autopsies a greater degree of inflammation in the lower than upper half of the œsophagus, even when the infant had stomatitis at the time of death.

Œsophagitis occurring from faulty regimen or anti-hygienic conditions is not accompanied by as much thickening of the walls of the tube as often occurs in some other portions of the digestive canal, as, for example, in the colon. Diphtheritic inflammation of the œsophagus is accompanied by so great infiltration of the mucous membrane and underlying connective tissue that I have seen the œsophageal walls three or four times the normal thickness.

Occasionally ulcerations of the œsophageal mucous membrane are observed in the lower part of the tube, and Billard describes the ulcerative form of œsophagitis. At the first autopsies at which I observed these ulcers, I supposed that they were pathological, and indicated a severe grade of inflammation; but a more extended observation has convinced me that they are usually post-mortem, and are not at all dependent on inflammation of the œsophagus. The solvent power of the gastric juice not only causes ulceration in the stomach, but entering the œsophagus may and not infrequently does produce a solvent action on the mucous tissue there. At the meeting of the London Pathological Society, March 4, 1852, Dr. Graily Hewitt presented a specimen in which the gastric juice had not only eaten entirely through the coats of the œsophagus an inch above the stomach, but had even attacked the left lung. Over the age of six months inflammation of the œsophagus is rare.

The symptoms of œsophagitis, in young and emaciated infants, in whom it ordinarily occurs, are not well pronounced. Pain in deglutition, or tenderness on pressure over the œsophagus, if present in these infants, is ordinarily not appreciable, nor have they seemed to me to vomit oftener than other infants of this class who suffered from indigestion and gastro-enteritis, without œsophagitis. It is, therefore, difficult to diagnosticate œsophagitis in them. It is, according to my observation, oftener present than absent in spoon-fed infants of three months or under who have persistent stomatitis and entero-colitis.

Treatment.—In the œsophagitis of foundlings and ill-nourished infants, which arises, as has been stated, from faulty regimen, no treatment is required apart from that designed to relieve the stomatitis or entero-colitis with which it occurs. Attention must be directed mainly to the diet and hygienic management. The remedial measures proper for such patients are more fully detailed in our remarks on entero-colitis. Œsophagitis produced by swallowing corrosive or highly irritating substances requires the same treatment as in the adult, to wit, poultices, demulcent drinks, etc.

CHAPTER VI.

INDIGESTION, CONGESTION OF STOMACH, GASTRITIS, FOLLICULAR GASTRITIS, DIPHTHERITIC GASTRITIS, POST-MORTEM DIGESTION, SOFTENING.

Indigestion is more common during infancy than in any other period of life. While the digestive organs in the adult readily assimilate a great variety of food, it is necessary for the well-being of the infant that its diet be simple and carefully prepared. Departure from this rule leads to indigestion and ulterior diseases.

After the age of two years a mixed diet is readily assimilated, the digestive function less frequently disordered, and indigestion presents few peculiarities to distinguish it from that of the adult.

Indigestion in some children is habitual; in others the digestive process is ordinarily well performed, but, from some temporary derangement of system or error of diet, an acute attack of indigestion occurs. Hence, two forms of this ailment may be described: first acute, referring to temporary attacks; secondly, chronic, referring to the habitual state.

Causes.—The causes of indigestion are twofold: first, the condition of the digestive function independently of the aliment; secondly, the unwholesome or improper character of the ingesta. Anything which lowers the vital powers may be a predisposing cause of indigestion, by impairing the function of the organs which assimilate the food. Impure

air and personal uncleanliness, protracted hot weather, and previous disease, are, among the common predisposing causes. The strong country child can thrive upon a diet which, given to the more feeble child of the city, would produce a deleterious results. During the summer months it often happens that an infant in the city cannot digest properly any food given to it except the mother's milk; and from this results much of the infantile sickness and mortality which make this season of the year much dreaded by parents. There is a natural difference in children, as regards liability to disordered digestion. Some do well upon a diet which given to others similarly situated occasions vomiting, gastralgia, and flatulence.

In the majority of cases of indigestion, however, the fault does not exist in the child. It is fed too often or irregularly, or upon a diet that is unwholesome or indigestible. It is well known that the milk of the mother or the wet-nurse is liable to changes which render it for the time unsuitable for the infant. Her food may be of such a quality, or her mind so excited, or some function of her system so disordered, as to effect a temporary change in the constitution of the milk. The occurrence of the catamenia, or of gestation, in mothers who are suckling, not infrequently produces this unfavorable result.

Indigestion is most common in those infants who, deprived of the mother's milk, are intrusted to wet-nurses, or fed from the bottle. The milk of the wet-nurse, from not agreeing with the age of the infant, from irregularity in her mode of life, from the acescent nature of her food, or from other causes which are not appreciable, may disagree with the infant, and be imperfectly digested.

The most common cause of indigestion in the infant is artificial feeding. This, in the cities, is productive of a great amount of gastric and intestinal derangement and disease. The younger the infant, the less frequently does it thrive if brought up by hand.

Whatever care may be bestowed in the preparation of its food, whether cow's or goat's milk, or farinaceous substances be used, there is seldom that healthy nutrition which is observed in infants who receive the breast-milk. The "swill milk" in common use among the poor families of this city is totally unfit for the feeding of infants, and is apt to cause flatulence, acidity, and indigestion. Acute indigestion occurs in children of any age from food unsuitable in quality or quantity, which produces gastralgia and other symptoms to be detailed hereafter. Those who suffer habitually from malassimilation are especially liable to such acute attacks.

In the period of childhood, chronic indigestion is much less frequent than in infancy, but children are, perhaps, more subject than infants to the acute form. This is induced by ingesta taken in too large quantity, or of a kind which is with difficulty digested. Cherries, currants, raisins, and the parenchyma of oranges and lemons, dried fruits, and confectionery, which are so often heedlessly given to children, are common causes of acute attacks of indigestion. These substances, being but partially digested or not at all, and sometimes accumulating for days in the stomach or intestines, may lead to a very serious and dangerous condition.

Symptoms.—Before describing the symptoms of indigestion I wish to direct attention to one form of vomiting in young infants which is usually attributed to indigestion by the young practitioner, but which really has no pathological significance. I refer to vomiting or regurgitation of milk in hearty and well-nourished infants, resulting from too frequent nursing or over-nursing. It occurs without previous nausea, and with little effort. The relatively small size of the stomach in young infants, its position more vertical than in older children, and the little development of the fundus, which is the proper receptacle of the milk, favor this regurgitation. The milk that is ejected is unchanged if it be returned immediately after the nursing, but if some moments have elapsed the casein is more or less coagulated. Little harm is done by this loss of nutriment, if the infant appear well and thriving. It is, indeed, salutary, for if the food, that is in excess of what is wanted, and in excess of what can be digested, be retained, it undergoes fermentation, and becoming an irritant causes indigestion and diarrhœa. The remedy consists in less frequent or less prolonged nursing, and allowing the infant to lie quietly in the crib after each nursing.

But vomiting is a symptom that should always arrest attention, and its cause be ascertained. If the child cease to grow, and lose its vivacity, the vomiting has pathological significance. Frequent vomiting, without other marked symptoms referable to the digestive apparatus, and with evident loss of flesh and strength, is, in most cases, a symptom of gastric indigestion, or of incipient meningitis. The presence of mucus in the ejected matter, eructation of gas, and the apparent absence of headache, and of other meningeal symptoms, apart from the vomiting, aid in establishing the diagnosis of gastric indigestion.

With these preliminary remarks, we will proceed to consider the symptoms, first, of habitual, and next, of acute temporary indigestion.

The nursing infant, if the milk continually disagree with it, is fretful. It has a discontented aspect; it seldom smiles, and is not amused by playthings, or is only amused for a short time. Its features are pallid, and bear the appearance of faulty nutrition. Its body and limbs are more or less wasted, or are soft and flabby. Vomiting is frequently present, and sometimes a large mass or masses of casein are ejected, which have evidently lain a considerable time in the stomach. The bowels may be constipated or loose, and the evacuations are unhealthy. This state of the infant continuing prevents the necessary rest of the mother, and may affect unfavorably her health, so as to reduce the quantity of her milk, or render it still more unwholesome.

In habitual indigestion of young children fermentation of the food occurs to a great extent, instead of normal digestion, and the fermentation results in the production of acids. Whatever irritates the gastro-intestinal surface, causes an increased secretion of mucus, and it is believed that the mucus, since it is alkaline, prevents to a great extent the digestive action of the pepsin, which requires an acid medium, so that lactic, butyric, and the fatty acids result. This acid fermentation beginning in the stomach, extends to the intestines as the food is carried downward. Hence the acid breath, sour-smelling ejecta, fetid stools,

flatulence and colicky pains, indicating both gastric and intestinal dyspepsia, so common in young improperly fed infants.

Habitual indigestion is, as might be expected, more common and severe in artificially fed infants, than in those at the breast, and it is more likely to result in gastro-intestinal catarrh. In rural localities where children are much of the time in the open air, have good constitutions, active digestion, and fresh food, dyspepsia is comparatively rare, but in large cities, in which the conditions of life are so different, its occurrence is common. Gross carelessness in the feeding, and ignorance on the part of mothers of the dietetic requirements of young children, contribute greatly to its frequency.

Attacks of *acute indigestion* not infrequently occur from careless and improper feeding, in children who are habitually dyspeptic, as well as in those whose digestive function is usually well performed. In these acute attacks young children, especially infants, often suffer much from colicky pains, gastralgia or enteralgia. Their countenance indicates suffering, they utter sharp cries; their thighs are flexed over the abdomen, and moved from side to side. Warm spirituous lotions, friction or gentle pressure upon the abdomen, gives some relief, especially if it be attended by the expulsion of flatus. Vomiting, or an evacuation of the bowels, commonly removes the offending substance, and the pain subsides.

Attacks of acute indigestion come on suddenly, and occasionally are so severe that they produce dangerous symptoms, as eclampsia. Apart from pain, or a sensation of weight or fulness in the abdomen, symptoms of a reflex character frequently occur, such as headache, drowsiness or languor, sudden twitching of the limbs premonitory of convulsions, and even severe or repeated convulsions. One of the most severe attacks of eclampsia which I have seen, occurred in a boy of eight or ten years, induced by swallowing the pulp of oranges, which he had been in the habit of eating, and which had accumulated in the stomach and intestines. The expulsion of the offending substance gave immediate relief. In some children with acute indigestion, the pulse is notably accelerated, the face flushed, the surface hot, and the temperature elevated two or three degrees above normal.

As the child advances in years, and becomes stronger, its digestive function is more active, a greater variety of food can be assimilated, and indigestion, whether temporary or habitual, is less frequent than in the first years of life.

Prognosis.—Indigestion in the adult, when not due to organic disease, involves little danger to life, but in infancy its consequences are often serious. Habitual indigestion in the infant, whether due to the bad quality of the breast-milk, or to artificial feeding, is liable to cause inflammation of the buccal, œsophageal, gastric, or intestinal mucous membrane, and, in some patients, of two or more of these divisions of the intestinal tract. Thus, especially in the warm months, the acid products of indigestion often cause a dangerous catarrhal inflammation, accompanied by vomiting and frequent stools. Many cases of atrophy in infants, characterized by arrested growth and gradual loss of flesh and strength, till, perhaps, the features have a sunken and senile appearance from the waste, and the skin lies in wrinkles, originate in

habitual indigestion. Henoch points out the frequency of gastro-malacia in infants who have suffered from severe indigestion accompanied by the abundant production of acids. The softening of the stomach is believed to be largely, if not entirely, cadaveric, the result of post-mortem digestion, from the presence of pepsin and the acids of fermentation. The gastric mucous membrane can be readily scraped away by the nail, and it presents a gelatiniform appearance. Sometimes even the stomach is perforated, and the adjacent organs are acted on by the corrosive liquids.

If the dyspepsia have not continued so long as to cause inflammatory complications, prompt recovery is probable by the use of suitable food and corrective medicines. If such complications be present, recovery can only be gradual.

Diagnosis.—Habitual indigestion does not usually continue long without the occurrence of more or less gastro-intestinal catarrh. The poor nutrition and appetite, the unhealthy, flatulent stools, containing mucus, the vomiting, and occasional colicky pains, are symptoms which plainly indicate a dyspeptic origin. Attacks of acute indigestion are also easily diagnosticated, in most instances, by the sudden occurrence of the symptoms, such as vomiting, pain in the abdomen, or a sensation of fulness, eructation of gas, etc., and the speedy subsidence of symptoms when the cause is removed. But sometimes, especially in children over the age of two or three years, the symptoms may so closely resemble those of other acute diseases, that a careful examination is required in order to make a clear and correct discrimination. Thus I have related above the history of a case in which the febrile movement and expiratory moan closely resembled those of pneumonia, but the symptoms quickly abated on the expulsion of a considerable quantity of orange-pulp. An attack of acute indigestion, attended by vomiting, rapid pulse, elevated temperature, with perhaps some erythema, may be mistaken for the commencement of one of the febrile diseases to which children are so liable. If, on examination of the fauces, no redness of the throat be observed, scarlet fever and diphtheria can be excluded. By a free evacuation of the bowels, the symptoms abate, and the attack ends, so that if there were any doubt in the diagnosis it is soon dispelled.

When eclampsia results from an attack of acute indigestion, the physician is often compelled to act promptly without a clear diagnosis, but the result of treatment soon renders the nature of the attack apparent.

Treatment.—The first indication in treatment is obviously the removal of the cause. In *acute* indigestion, when there is reason to believe that there is some offending substance in the stomach or intestines, if the symptoms occur soon after the substance is taken, an emetic may be administered, and ipecacuanha, in syrup or powder, is a safe and usually efficient remedy. If several hours have elapsed a purgative should be given, as castor oil, either alone or in combination with syrup of rhubarb.

If the symptoms be urgent, especially if convulsions be threatened, we should not wait for the slow action of a purgative, but should resort to enemata to open the bowels. Sometimes the pain in acute indiges-

tion is such as to require the use of opiates. In the infant there is often an excess of acid in the stomach and intestines, which is best treated by alkaline remedies, as lime-water in combination with the opiate. The following mixture will be found useful in such cases:

℞.—Tinct. opii deodorat., or liq. opii composit. (Squibbs) . gtt. xij.
Magnes. calcinat. . . . . gr. xij—xxiv.
Sacch. alb. . . . . ℥j.
Aq. anisi . . . . . ℥iss.—Misce.

Dose, the bottle being first shaken, one teaspoonful every two hours to a child a year old, until relief. If there be much pain, it is well to add a little chloroform or Hoffman's anodyne to the mixture.

Or the following mixture:

℞.—Tinct. opii deodorat., or liq. opii composit. . . . gtt. xij.
Bismuth. subcarbonat. . . . . ℥iss.
Syr. simplic. . . . . ℥ss.—Misce.
Aq. cinnamomi . . . . . ℥j.

Shake bottle thoroughly and give one teaspoonful.

If in the acute indigestion of infants diarrhœa occur, the camphorated tincture of opium, in combination with chalk mixture, may be given, fifteen drops of the one to a teaspoonful of the other, or the above mixture. Infants, whose diet consists largely of cow's or goat's milk, digest with most difficulty the casein, which often passes the bowels in an imperfectly digested state, or it collects in a large and firm mass in the stomach, causing gastralgia and rendering the child fretful till it is vomited. I have elsewhere recommended, as important to prevent these attacks of acute dyspepsia, the use of the upper third of the milk, which contains less than the average casein, and the addition of an alkali to the milk, which retards coagulation till it begins to be acted upon by the gastric juice, and tends to prevent the formation of large and firm caseous coagula in the stomach. The addition of a little farinaceous food, as barley water to the nursing-bottle, will sometimes produce the same effect by mechanically separating the particles of milk. Peptonized milk, as recommended in our remarks on the hygienic treatment of intestinal catarrh, will also be found useful in certain cases.

In *chronic* indigestion the means of relief are different. They are twofold: first, as regards change of diet; secondly, measures to improve the digestive function. Spoon-fed infants, suffering from habitual indigestion, require the utmost care as regards the character of their food, its preparation, and the times of feeding. Often it is best, if practicable, to procure a wet-nurse, and sometimes removal to a more salubrious locality is followed at once by improvement in the digestive function. If the infant be already wet-nursed, the milk should be examined microscopically and otherwise, and inquiry should be instituted in reference to the health and diet of the wet-nurse. Sometimes a change of wet-nurse is advisable. For facts and considerations bearing on this point the reader is referred to the chapters relating to regimen.

Children with chronic indigestion are occasionally much benefited by the moderate and judicious use of alcoholic stimulants. They should be given sparingly with their food, and should be discontinued as soon as

the digestive function is fully restored. M. Donné and some other French writers recommend the habitual use of wine for infants even in a state of health, but there are reasons, moral as well as physical, why alcoholic stimulants should only be used as medicines, and not in a state of health.

If the case be one of simple or uncomplicated indigestion, pepsin or lactopeptin of the shops and tonics may be employed. In many instances, however, especially in infancy, gastro-intestinal inflammation has supervened, and in such cases those remedies should be employed which exert a favorable, or, at least, not an unfavorable effect on the inflamed surface over which they pass.

In habitual indigestion remedies are obviously required which increase the quantity of the digestive ferments. The following will be found a useful prescription in cases of indigestion in which gastro-intestinal catarrh has supervened:

℞.—Acidi hydrochlorici dilut. . . . . gtt. xvj–xxxij.
Lacto-peptini or pepsini . . . . . ʒj.
Bismuth. subnitrat. . . . . ʒij.
Syr. simplic. . . . . ℥ss.
Aquæ destillat. . . . . ʒiij.—Misce.
Shake bottle, and give one teaspoonful before each feeding.

If the stools continue frothy and offensive on account of the fermentation, the following will be found beneficial:

℞.—Creasoti or acidi carbolici . . . . . gtt. ij to iv.
Syr. simplic. . . . . ℥ss.
Aquæ destillat. . . . . ʒjss.—Misce.
Dose, one teaspoonful every two hours.

In children over the age of three or four years, the vegetable tonics are often useful, as quinine in half-grain or one-grain doses, and the elixir of calisaya bark. Iron may also be given, especially the milder preparations, as the citrate in anæmic cases.

Among the useful vegetable stomachics and tonics may also be mentioned the compound tincture of cinchona, compound tincture of gentian, infusion of columbo, fluid extract of columbo, and fluid extract of cinchona.

If chronic indigestion be complicated with gastro-intestinal inflammation, subacute or chronic, for this is the form which is usually present, there are still certain tonics which may be advantageously administered. Columbo and the compound tincture of cinchona are often useful in these cases, and of the chalybeates wine of iron or the citrate of iron and ammonium or the liquor ferri nitratis may be safely administered. In most cases, however, change in the diet properly made will be found more useful than tonic and corrective medicines.

Infants affected with diarrhœa from indigestion often improve under the use of powders consisting of equal parts of subnitrate of bismuth and pepsin or lactopeptin. An infant of three months can take three grains of each every three hours, or before each feeding.

Dyspepsia often rapidly disappears by hygienic measures without the use of medicines, as by removal from the city to the country, outdoor

exercise, or, if the patient be an infant, by being carried into the open air daily. In infants, also, marked improvement is often observed on the approach of the cool and bracing weather of autumn and winter.

Congestion of the Stomach.

Passive congestion of the stomach is described among the diseases of this organ by Billard; but it is a pathological state of little importance in itself. It occurs in newborn infants, asphyxiated at birth and with difficulty resuscitated. In these cases there is generally intense capillary congestion throughout the system. The mucous membrane of the stomach is injected, but not more than that of the mouth or intestines. If circulation and respiration be fully established, this injection of the capillaries subsides. No treatment is required, except measures to promote the circulatory and respiratory functions. In cyanosis and atelectasis there is often general congestion of the capillaries of the systemic circulatory system, on account of the obstruction to the flow of blood through the heart in the one disease and through the lungs in the other. There is in these cases passive congestion of the stomach, but not more than of other organs.

Gastritis.

Inflammation of the stomach, except when produced by the direct contact of some irritant, is rare in infancy and childhood, independently of disease in some other portion of the intestinal tract. Cases have, however, been reported in which it was not known that any irritating ingesta had been taken, and in which a careful examination revealed a healthy or nearly healthy state of other portions of the digestive tube. The subjects were, for the most part, young infants. The following is an example related by Billard:

An infant, four days old, remarkable for the color of his face and firmness of flesh, refused the breast, and vomited yellow, acid matter. On the following day the vomiting had increased, the legs were œdematous, face pallid and pinched, respiration difficult, skin cold, pulse slow and irregular, and pressure on the epigastric region produced cries indicative of pain.

Third day: general sinking; face thin and expressive of great pain; stools natural.

Fourth and fifth days: condition the same. Death occurred on the sixth day; and the autopsy was made on the day following.

With the exception of slight pneumonitis, no disease was discovered in any part of the system beside the stomach. The mucous membrane of this organ was intensely vascular near the cardiac orifice and along the lesser curvature. This part was also tumefied, and could be easily raised with the finger-nail. The remainder of the gastric surface was hyperæmic, but to a less extent.

This case is interesting as showing what may happen, though rarely. A nursing infant is seized with gastritis without apparently having taken

any irritating ingesta, and without other disease of the digestive apparatus. It is probable, however, that, in cases like the above, the cause, if ascertained, would be found in the ingesta; perhaps drinks too hot, perhaps elements of colostrum, or pathological elements in the milk, which might produce gastritis in young infants in whom the mucous membrane is delicate and sensitive.

Gastritis is not uncommon in infancy in connection with inflammation of the intestines. The latter inflammation is sometimes apparently subordinate to the former, and, if such patients die, the fatal result is due mainly to the gastric disease. The reverse is, however, the rule. The gastritis is ordinarily subordinate to the intestinal catarrh.

Cause.—Gastritis, as I have observed it in infants, has been in most cases due in great part to the continued use of improper food, of food not suitable to the age of the child, and which was, therefore, with difficulty digested. Milk, acid or otherwise unwholesome, farinaceous substances, stale or of an inferior quality, and not properly prepared, drinks too hot or too cold, may be specified among the causes. Therefore, this disease is most common in bottle-fed infants, and is comparatively rare in those who receive abundant and wholesome breast-milk. Anti-hygienic agencies, apart from the diet, no doubt exert some influence in the production of gastritis, as they do of stomatitis. Uncleanliness, and residence in damp and dark apartments, or in an atmosphere loaded with noxious gases, produce a condition of system which strongly predisposes to these inflammations, if, indeed, they may not be enumerated among the direct causes.

Rilliet and Barthez have called attention to the fact that certain medicinal substances given to children occasionally cause gastritis. They have observed this effect from the use of tartar emetic, kermes mineral, and croton oil. Gastritis occurring in this way may or may not be associated with inflammation in contiguous portions of the digestive tube. Elsewhere I have related a case in which gastro-enteritis occurred in a child nine years old, after having taken a considerable quantity of kerosene oil for spasmodic croup; and Dr. Northrup, curator of the N. Y. Foundling Asylum, has seen the lesions of gastritis in infants that took carbonate of ammonium in the last days of life.

Inflammation of the stomach is thought by some to accompany measles and scarlet fever during the eruptive period, but this opinion is probably incorrect. If it occur, it corresponds with the stomatitis and dermatitis of those diseases, and disappears as they subside. It is mild, and accompanied by few symptoms. I have, as stated in the remarks on scarlet fever, examined in certain instances the stomachs of those who have died during the eruptive period of these diseases, and found them free from any appreciable inflammatory lesion.

Age.—From the records of about seventy cases of inflammatory disease of the digestive mucous membrane which I have preserved, it appears that gastritis is rare over the age of six months. On the other hand, it is not uncommon in infants under the age of three months who are deprived of breast-milk. I have met it chiefly in foundlings fed with the bottle, and having at the same time entero-colitis and often also stomatitis and œsophagitis. In these cases there is sometimes con-

tinuous or almost continuous injection and thickening of the mucous membrane, from the lips to near the pyloric orifice of the stomach, and even beyond this orifice in the intestines. The following is an example of gastritis as it frequently occurs in foundling institutions:

Case.—R. W., female, two weeks old, was admitted into the New York Infant Asylum, August 24, 1865, anæmic and somewhat emaciated. She was in part wet-nursed, and in part bottle-fed. The emaciation increased, and nearly the entire buccal cavity became covered with the confervoid growth of thrush. On September 4th, diarrhœa commenced. Borax was used for the mouth, and alkalies and astringents to check the diarrhœa, but without material improvement.

The following was the record for September 7th: "Cries almost constantly, with feeble or whining voice; still has thrush; nurses and does not vomit; stools five or six daily, and green; pulse 136, feeble." Death occurred September 8th.

Autopsy September 9th.—Mouth and fauces not examined; mucous membrane of œsophagus vascular in its whole extent, with slight thickening, but without ulceration; mucous membrane of stomach injected like that of the œsophagus, and somewhat thickened, except in its pyloric extremity, where the appearance was natural, or nearly so; the color in the central part of the inflamed gastric membrane was deep red; no thrush was noticed, except on the buccal surface during life; along the great curvature of the stomach were white flakes, resembling those of thrush, but which were found by the microscope to consist mainly of oil-globules and epithelial cells, without the cryptogamic formation; mucous membrane of small intestines healthy in their whole extent, except slightly increased vascularity in a few places in the ileum; mucous membrane of colon much injected throughout, except near the ileo-cæcal valve, where the vascularity was slight; in the transverse and descending colon the redness was pretty uniform; and the membrane was thickened, but not ulcerated; solitary glands and Peyer's patches moderately elevated.

The observations of Valleix show how frequently gastritis is associated with severe attacks of thrush. In twenty-three of his cases of the latter disease, in which the condition of the stomach was noted after death, this organ presented inflammatory lesions in seventeen, and in three others appearances which may or may not have been due to inflammation.

Symptoms.—A difficulty exists in isolating and defining the symptoms of gastritis, from the fact that it commonly coexists with other inflammations of the digestive tube. Though we may never be able to diagnosticate this catarrh as certainly as we can croup or pneumonitis, still, there are symptoms which arise directly from the gastritis, and with care we may be able to distinguish them from those symptoms which are due to other pathological states.

If gastritis be acute, pain is present. In the above case from Billard, as well as in a case observed by myself and related under the head of gelatinous softening, there were frequent cries, and the countenance indicated much suffering, until the stage of collapse. If there be less intensity of inflammation, and the disease be more protracted, as is ordinarily the case, the pain is not so severe, and it may be so slight as not to attract attention. Sometimes there is tenderness, so that pressure upon the epigastric region is badly tolerated. Vomiting is regarded as

one of the most constant symptoms. The infant after nursing seems in distress till the milk is returned, but it nurses with avidity in consequence of the thirst, if it be not too exhausted or feeble. The dejections may be quite regular throughout the disease, as in the case from Billard. There is ordinarily, however, diarrhœa from the presence of entero-colitis. The pulse is sometimes accelerated, and sometimes nearly natural. The emaciation in gastritis is rapid, since not only the milk is in great measure vomited, but the digestive function, so far as the stomach is concerned, is seriously impaired. The features become wrinkled and senile, the eyes hollow, the limbs attenuated, and the cranial bones uneven. Death occurs from exhaustion.

Anatomical Characters.—Simple gastritis may affect the entire mucous surface of the stomach, or be limited to a certain part. The part which is most likely to escape is that toward the pyloric orifice. This portion of the organ is sometimes found in nearly or quite the normal state, while the cardiac half or two-thirds is inflamed. The vascularity of the diseased surface is not uniform. In one place there is simple arborescence; in another intense continuous redness, and between these two extremes are different grades of vascularity. The mucous membrane is somewhat thickened, softened, and the secretion of mucus increased. Extravasation of blood is not infrequent under the mucous membrane, usually in points, and mucus may be mixed with more or less blood. Small shreds or portions of coagulated milk are often found with the mucus attached to the gastric surface. I have observed, though rarely, small superficial ulcers at the point where the inflammation had been most intense.

Diagnosis.—In protracted cases, when entero-colitis is present, it is difficult to make a positive diagnosis. Our opinion must then be little more than a plausible conjecture. In the acute attacks we can diagnosticate the gastritis with more certainty. If a young infant affected with sprue be seized with pain, and it vomit often; if emaciation be rapid, and there be no diarrhœa, or diarrhœa not sufficient to account for the prostration; if the buccal mucous membrane, dotted with the points of thrush, present a dry appearance and the deep red color of severe stomatitis, there can be little doubt of the presence of gastritis. The diagnosis is rendered more certain by signs of tenderness when pressure is made upon the epigastric region.

Prognosis.—Like other inflammations, gastritis is probably sometimes so mild that it does not materially increase the suffering or danger of the child. This mild form of the disease under favorable circumstances soon subsides. In other cases, by the continuance or increase of the cause, the inflammatory process becomes more severe and extensive, resulting even in disintegration of the mucous membrane. Those cases are especially severe and likely to end fatally, which are protracted and accompanied by severe thrush, with a desiccated appearance of the buccal surface, or with entero-colitis. Pain, vomiting, and rapid emaciation in such children indicate the speedy approach of death. Improvement in the stomatitis or entero-colitis is a favorable indication, but these inflammations may improve without corresponding improvement in the gastritis.

Treatment.—All food or drinks, except those of a bland and unirritating nature, should be forbidden. If practicable, the young infant should take no nutriment except the mother's milk or that of a wet-nurse. Since there is an excess of acid in inflammation of the mucous coat of the digestive tube, lime-water may be advantageously given in combination with breast-milk. Opium is required to relieve the pain and quiet the action of the stomach. The camphorated tincture of opium, in doses of four or five drops to a child a month old, or the syrup of poppy, tincture of opium, or liquor opii compositus, in proportionate doses, may be administered. If there be thirst, a little gum-water should be given frequently. If there be much emaciation and the vital powers are failing, it will be necessary to resort to the use of stimulants. Stimulating enemata are preferable to stimulants given by the mouth. Much benefit may be anticipated from local measures. Irritation should be produced upon the epigastrium by mustard or other means, followed by fomentations. It is rarely, perhaps never, proper to use leeches, if the patient be a young infant. Death occurs from exhaustion, and it is, therefore, important that the vital powers should not be reduced. If the child be weaned, the diet at first should be restricted to arrowroot, rice-water, barley-water, or similar bland substances. In advanced stages of gastritis, animal broths and jellies may be required.

Follicular Gastritis—Diphtheritic Gastritis.

The pathological character of *follicular* gastritis is similar to that of follicular stomatitis. It is an inflammation affecting the gastric follicles and ending in their ulceration. It is not a frequent disease; it occurs in young infants. Billard observed fifteen cases. The symptoms in these patients were similar to those in simple gastritis of a severe form. The emaciation and prostration were rapid, and death occurred early. We can only diagnosticate the gastritis without determining its follicular character. How many recover it is impossible to ascertain, but the disease is likely to be fatal on account of the intensity of the inflammation, not only of the follicles but of the intervening mucous membrane. The treatment is that of gastritis.

Diphtheritic gastritis is infrequent. It occasionally occurs during epidemics of diphtheria. Allusion is elsewhere made to a case treated in the Nursery and Child's Hospital of this city, in December, 1859. The patient, eighteen months old, previously had had protracted entero-colitis, and died exhausted after a brief attack of diphtheria. There were lesions referable to the entero-colitis, and the body was much emaciated. The diphtheritic exudation was found covering the fauces, epiglottis, glottis to the rima glottidis, the entire œsophagus, and almost the entire stomach. The mucous surface underneath was injected; that of the œsophagus and stomach especially was very vascular, softened, and thickened, and the submucous connective tissue was infiltrated.

The pseudo-membrane, taken from the epiglottis and examined under

the microscope, presented an amorphous appearance; no cells were noticed in it, and fibrillation was not distinct; that from the stomach was found to consist almost entirely of cells, the plastic corpuscles of some writers, the pyoid of others. The digestive process, so far as the stomach was concerned, had evidently been almost if not entirely suspended, and hence in part the sudden prostration. Diphtheritic gastritis probably does not occur without general infection of the system with the diphtheritic virus. The proper treatment is the use of lime-water or one of the solvents of pseudo-membranes which do not irritate the mucous membrane, while the constitutional treatment proper for diphtheria is employed.

Post-mortem Digestion—Softening.

It is now many years since the attention of the profession was directed to disorganization of the coats of the stomach, which is sometimes observed at post-mortem examinations. John Hunter first ascertained that the gastric juice begins to have a solvent effect on the tissues of the stomach soon after death. Though Hunter erred, when he stated that the coats of the stomach are more or less digested in all or nearly all cases, it is certain that post-mortem digestion does take place in many cadavers, so that in a few hours after death the gastric mucous membrane is destroyed to a greater or less extent, and occasionally the stomach is perforated or is even severed from its connection with the œsophagus. I have seen several examples of this post-mortem digestion in infants.

Some of the cases of supposed pathological softening of the stomach reported by the older observers, seem to have been such as I have described, namely, cadaveric. Yet there are two other kinds of softening occurring in children, which are strictly pathological, the one designated white, the other, by Cruveilhier, gelatinous.

White softening of the gastro-intestinal mucous membrane results from deficient alimentation. It has been observed only in anæmic and ill-nourished children. The mucous membrane in such patients loses its firmness, and is easily separated from the subjacent tissue. This softening has no connection with any inflammatory process. It is the result of the low vitality of the patient. I believe that, in a large proportion of infants whose systems have been reduced and blood impoverished for a considerable time, the gastro-intestinal mucous membrane will be found after death less firm and resisting than in those who have been habitually robust.

A vague opinion exists in the minds of most physicians as to the nature and even appearance of the so-called *gelatinous* softening of the stomach, and the following observations will be cited in order to give a clearer idea of it.

Billard has recorded two cases with his usual minuteness, and adds: "What inference shall be drawn from the preceding facts and considerations? None other than that the gelatinous softening of the stomach consists in a disorganization of the mucous membrane of this viscus,

caused by an acute or chronic phlegmasia; that this disorganization is characterized by an accumulation of serum in the walls of this organ; the intumescence and gelatinous consistence of the mucous membrane in a part usually circumscribed, situated more frequently in the greater curvature, and about which the membrane exhibits more or less evident traces of an acute or chronic phlegmasia. . . . The softening now under consideration must not be confounded with another kind of softening" (white) "which does not usually succeed an acute phlegmasia."

Billard believes that, while gelatinous softening results from inflammation of the mucous membrane, its proximate cause is an afflux of serum to the part in which the disorganization occurs. In one of the two cases which he reports, he thinks that the inflammation was acute, but in the other chronic, and, therefore, presenting less vascularity.

West, in speaking of gelatinous softening, says: "Softening of the stomach varies in degree from a slight diminution in the consistence of the mucous membrane, to a state of complete diffluence of all the tissues of the organ. . . . When the change is not far advanced, the exterior of the stomach presents a perfectly natural appearance, but on laying it open a colorless or slightly brownish tenacious mucus, like the mucilage of quince-seed, is found closely adhering to its interior, over a more or less considerable space at the great end of this organ."

Cruveilheir says: "This softening often proceeds from the interior toward the exterior. There is at the beginning simple separation of the fibres by a gelatinous mucus, and in consequence the parietes are thickened and semi-transparent. . . . If the transformation be complete, the disorganized portions are removed layer after layer, those which remain becoming gradually thinner. The peritoneum alone resists for some time, but at length it is attacked, worn, and gives way, and perforation of the stomach results. The parts thus transformed are colorless, transparent, apparently inorganic, completely deprived of vessels, and exhaling an odor resembling that of milk."

Bouchut remarks: "Softening of the mucous membrane of the stomach in children at the breast is not a special disease which it is necessary to describe by itself. This alteration is always connected with other diseases, and especially with disease of the large intestine, the knowledge of which fact has been too long neglected. It is the consequence of the acidity of the liquids contained in the digestive tube of young children, liquids which are very acid in the disease we have above referred to."

Dr. Carswell states that there is a pathological softening of the mucous membrane of the stomach, and that when it occurs the symptoms may be those of gastritis or enteritis.

Rokitansky says of this form of softening: "If we consider, in addition to the above remarks, the uniform localization of the disease, that in none of its stages it presents, either at the point of the softening or in its vicinity, hyperæmic injection or reddening, and that we are still less able to demonstrate upon the inner surface of the stomach or in the tissue of its coats the products of inflammation, we are constrained to infer the non-inflammatory nature of the affection."

Without extending these extracts, it is seen that eminent authorities

not only disagree in reference to the cause of gelatinous softening of the stomach, but that they also differ in their description of its appearance. This diversity of opinion is most likely attributable to the fact that the two kinds of softening have been confounded. Rokitansky and Bouchut probably refer to cases of white softening, which occurs in atonic states of the tissues in feeble infants, and, therefore, have concluded that softening of the stomach is not inflammatory. I believe, from my observations, that the opinion of Billard is correct, and that true gelatinous softening is the result of gastric inflammation, sometimes chronic, sometimes acute. But I have seen appearances which led me to think that the immediate causes of the softening continue to operate after death, so that its amount is less at the time of death than a few hours subsequently.

The following case, which was watched by myself with great interest, from beginning to end, is an example of inflammatory softening:

Case.—G. S., male, robust, was born July 10, 1865. The mother not being able to suckle the infant, and the danger of artificial feeding in the warm months being well understood, a wet-nurse was procured. About the 14th of July, this wet-nurse having insufficient milk, another was procured temporarily, who suckled the infant till July 20th, when a third wet-nurse was engaged, whose child, healthy and thriving, was six weeks old. Previously to this time the infant appeared well. It had uniformly nursed vigorously and seemed satisfied.

On the 22d of July, thrush, apparently mild, was observed in the mouth, and a powder, supposed to be borax, and labelled such, was obtained at a drug-store, to be used as a wash for the mouth. This powder was afterward ascertained to be alum. Five grains were dissolved in as many teaspoonfuls of water, and the mouth of the child was swabbed occasionally with it. A piece of linen, folded so as to resemble the tip of a nursing-bottle, was occasionally dipped into the solution, and the infant was allowed to suck it. The use of the alum was commenced about 6 P. M. In the first part of the evening the infant slept considerably, and of course did not nurse often, but about 8 P. M. it began to be very fretful, and it then nursed more frequently. It vomited once between 8 and 10 o'clock P. M. In order to quiet the infant, the tip soaked in the solution was often applied to the mouth, but there was scarcely any intermission in its crying. Through the night it vomited again once or twice, and about the middle of the night had one free liquid stool, which was passed with much tenesmus. The countenance of the infant was indicative of suffering, and its thighs were repeatedly flexed over the abdomen, as if that were the seat of its distress. Paregoric in two-drop doses was several times given through the night, and flannel soaked with hot whiskey was applied to the abdomen.

July 23d. In ignorance of the cause of the child's sickness, another wet-nurse was obtained early in the morning, and one-sixth of a drop of liq. opii compos. was given every hour, with the effect of inducing a little sleep. The tongue was very red, desiccated, and studded with more numerous points of thrush than on the previous day. It now refused to nurse, apparently from soreness of the tongue. At each attempt of the nurse to induce it to take the nipple, it rubbed the mouth across the breast, crying either from pain or disappointment. The alum was not used in the latter part of the night of the 22d, but late in the morning of

the 23d it was resumed, the mistake of the druggist not being discovered till midday, when it was estimated that about five grains had been used. Occasionally a little of the solution was placed in the mouth with a spoon so as to be swallowed, in the belief that the thrush affected the œsophagus. The infant continued to suffer much during the day, sleeping at times a few minutes. Its strength was evidently failing; respiration regular; pulse about 140; its alvine discharges yellow, of natural consistence and frequency.

Evening, 23d. Surface hot; it is very restless; pulse 150 to 160; tongue dry, intensely red, and dotted with points of thrush. Is treated with opiates, a little lime-water, and fomentations.

24th. In the first part of the day nursed pretty well; in the latter part, could be induced to draw the breast only once or twice. The symptoms to-day were the same as yesterday, with the exception of greater emaciation and prostration; cranial bones uneven, and features pinched.

25th. Pulse 140 to 148; strength rapidly failing, but it cries at times loudly. The milk of the nurse, placed in the mouth with a spoon, is often held a considerable time before it is swallowed, and deglutition seems difficult. Respiration in the first part of the day and previously, natural; in the latter part of the day, accelerated; dejections natural; no vomiting; appearance of tongue more natural than yesterday.

26th. Died to-day in a state of collapse at 12½ P. M. The hands were cold several hours before death, and the milk given it was regurgitated.

Autopsy twenty-two hours after death.—Much emaciation; no rigor mortis; cranial bones uneven; the upper part of the pharynx injected to the extent of about half an inch; from this point to the stomach membrane healthy; mucous membrane covering the cardiac two-thirds of the stomach disintegrated, almost diffluent, and in places detached from the subjacent tissues; mucous coat of the pyloric third of the organ nearly healthy; along the edge of the softened portion the mucous membrane was vascular to the extent of a few lines; the muscular and serous coats of the stomach underneath the softened portion were easily torn; the mucous membrane of the small intestine presented in places that degree of vascularity known as arborescence; there was no destruction or softening of its mucous membrane; the colon was healthy; the stomach was nearly empty; the contents of the small and large intestines were natural in color and consistence; the other viscera were healthy; in the left pleural cavity was about one ounce of transparent serum, and a less quantity in the right cavity.

It cannot be doubted that the softening in the above case was pathological. The weather at the time was warm, but the infant was placed on ice, and a pan containing ice was kept upon the abdomen. This infant died evidently of gastritis, the accompanying inflammation being subordinate, and in fact insignificant. At first it was a question with me whether the alum might not have caused the gastritis, so that the case should be properly placed in the category of deaths from swallowing corrosive substances. In order to determine this point, I administered alum daily to two kittens, commencing when they were seven days old. The quantity given to each was ten grains daily in two doses for three consecutive days, and on the two following days five grains. The only uniform result noticed was an increased flow of saliva, which washed some of the alum from their mouths, and occasionally slight vomiting.

There was not even any apparent inflammation of the buccal membrane from the alum.

Post-mortem appearances as in the above case, and similar ones recorded by Valleix and others, in which gelatinous softening coexisted with evident lesions of gastritis, render it highly probable, if indeed they do not demonstrate, that the softening is a result of the inflammation at the point where it occurs.

In Valleix's twenty-four cases of what he terms fatal muguet, softening of the mucous membrane of the stomach was one of the most common lesions, and at the same time, which is the point of interest, there were signs which showed conclusively the presence of gastric inflammation. The common coexistence of the lesions of gastric inflammation, such as redness and thickening, with gelatinous softening of the stomach, is certainly most reasonably explained on the supposition that the one results from the other.

I am not prepared to accept nor reject the theory of Billard, that the immediate cause of the softening is the afflux of serum, nor that of Bouchut, that it is an excess of acid.

It has been said that M. Baron was able to diagnosticate gelatinous softening. The symptoms are those of the severe forms of gastritis. The vomiting, great pain, restlessness, sudden and progressive emaciation, and, finally, collapse preceding the fatal result, without sufficient diarrhœa to cause the rapid sinking, are the symptoms on which the diagnosis is based. The treatment should be directed to the gastritis.

CHAPTER VII.

DIARRHŒA.

DIARRHŒA is frequent during the whole period of infancy. French writers describe several varieties, according to the character of the evacuations, as acescent, mucous, and serous. M. Rostan even describes fourteen distinct kinds. But the tendency of medical science in modern times is to simplify the nomenclature of diseases—to describe under a single name those affections which are essentially the same though differing somewhat in their features. Now, all the forms of diarrhœa in the infant may be so grouped as to reduce the number to not more than three or four. In this way repetition and prolixity are avoided, as well as an unnecessary refinement.

Non-Inflammatory Diarrhœa.

The most common form of diarrhœa is that enunciated in our heading, which writers sometimes designate by the term simple or spasmodic.

But often a diarrhœa which is non-inflammatory at first, becomes a catarrh. Thus the simple diarrhœa of infancy may become an entero-colitis from the continued use of improper diet.

Causes.—These are various. Conditions or agencies which have no appreciable effect in the adult often increase the number of evacuations in young children. Food which imperfectly digests, and some of which perhaps ferments, stimulates the intestinal follicles to excessive secretion, and increases the peristaltic movements by its irritating action, thus causing diarrhœa. Too frequent and abundant feeding is another cause, especially in young infants, some of whom may vomit the surplus food and remain well, but others do not. Food which cannot be assimilated becomes an irritant in consequence of fermentative change, and produces frequent and unhealthy evacuations. The late Dr. James Jackson, of Boston, directed attention to this cause of diarrhœa in his *Letters to a Young Physician.*

The mother's milk or the milk of the wet-nurse may disagree, either from some temporary derangement of her system, or continued ill-health, or from causes which are not understood. Non-inflammatory diarrhœa in the nursling is the immediate result, with perhaps subsequent inflammation. The milk in those cases frequently contains the elements of colostrum.

Fright or strong mental impressions will also in some children increase the number of evacuations. This cause being transient, the diarrhœa soon subsides.

Another cause is exposure to cold. Children who are insufficiently clothed in the winter season, who are taken from a heated room into a cool one without sufficient protection, or who lie uncovered at night, are very subject to diarrhœal attacks from the impression of cold on the system.

The cause of non-inflammatory diarrhœa may exist in the child itself. In some children the evolution of the teeth is attended by a relaxed state of the bowels, which ceases when the gum is pierced. Worms in the intestines may also operate as a cause. Diarrhœa is occasionally salutary within certain limits, and of course it is not strictly correct to call it a disease when it is a means of relief. If occurring from excessive or irritating ingesta, it is obviously conservative.

Symptoms.—Non-inflammatory diarrhœa may come on suddenly; at other times there are precursory symptoms continuing for some days. Whether or not there be antecedent symptoms depends chiefly on the cause. If this be exposure to cold, or the use of improper aliment, it commonly occurs immediately.

Among the prodromic symptoms sometimes present are restlessness, disturbed sleep, transient abdominal pains, nausea, or vomiting, and other symptoms of indigestion. The stools in simple diarrhœa differ much in color and consistence in different cases, and perhaps at different periods in the same case. In infants they are apt to be green. This color, which is a source of anxiety to the inexperienced, and especially to the parents, is often produced by trivial causes. Slight indigestion will produce it, and so will excess of food, even when bland and unirritating. The stools in infantile diarrhœa often contain parti-

cles of coagulated casein, but in children advanced beyond the period of first dentition they do not differ materially in appearance from the evacuations of the adult. They are usually passed easily, but if they be acid or in any way irritating, there may be more or less tenesmus, especially in infants. Sometimes before the evacuations, there is a sensation of fulness in the abdomen. In that form of diarrhœa which has been designated acescent, not only are the stools acid, but matters vomited have an acid odor, and give an acid reaction.

During the quiet hours of sleep, when no food and drinks are taken, the diarrhœa diminishes. If the complaint be slight, there is little thirst; but if the stools be frequent and thin, especially if they approach the watery character, the patient is thirsty. The appetite varies, the tongue is moist, and covered with a light fur, and there is often more or less meteorism, but no abdominal tenderness.

The features in this disease are pallid. In a few days, if the evacuations continue, there is evident loss of weight and flesh. The rotundity of the limbs is gradually lost, and the tissues become soft and flabby. But in most cases, when the malady has reached this stage, its original character is lost, and it has become inflammatory.

There is no constant fever in true non-inflammatory diarrhœa. Sometimes the pulse is accelerated in the latter part of the day, but usually only for a short time.

Certain epiphenomena, as Barrier terms them, occur at times in non-inflammatory as well as in inflammatory diarrhœa, as for example a sympathetic cough, or, which is more serious, cerebral complications. Convulsions or stupor, indicating the supervention of spurious hydrocephalus, may occur in either form of diarrhœa. This disease is described elsewhere.

Anatomical Characters.—It is obvious from the nature of this malady that it is attended by little or no structural changes perceptible to the anatomist. In cases supposed to be non-inflammatory, which have ended fatally either from the diarrhœa or an intercurrent disease, the most marked lesions observed have been more or less tumefaction of the intestinal glands, with perhaps diminished firmness and resistance of the mucous membrane. Cases like the following, which have usually been regarded as non-inflammatory, are not infrequent, but it seems to me probable that in at least a certain proportion of such cases the intestinal follicular apparatus has passed beyond the physiological state of an exaggerated functional activity, and that the disease should be designated a catarrh or inflammation. Inasmuch as non-inflammatory diarrhœa, if protracted, is very liable to become inflammatory, it is often difficult to determine whether the malady has undergone this change, even with the aid of a post-mortem inspection.

On the 7th of July, 1865, a foundling, one month old, died at the Infant Asylum. It was much emaciated, with eyes sunken and features pinched, at the time of its death. It was wet-nursed toward the close of its life, but the nurse's milk was insufficient. It did not vomit; did not have any marked acceleration of pulse (128 per minute), and its evacuations were about four daily and thin. The stomach and intestines were pale throughout. The solitary glands, particularly those in the

colon, and the patches of Peyer, were tumefied so as to be visible, and somewhat raised above the surrounding surface. But no lesions being observed which are characteristic of inflammation, the disease was regarded as non-inflammatory.

Niemeyer, with others, describes even the mildest forms of diarrhœa under the term catarrhal inflammation, and he appears to consider the transient effects of a purgative as an incipient catarrh. But it seems to me preferable, in the present state of pathological knowledge, to regard all those diarrhœas which immediately abate with the removal of the cause, and which are attended by no marked anatomical change, as non-inflammatory.

Prognosis.—In a large proportion of cases, non-inflammatory diarrhœa is not dangerous. With the adoption of suitable measures to remove the cause, and the use of medicines to control the discharges. the patient recovers. The remark already made may be repeated here, that occasionally diarrhœa is salutary within certain limits, as when there is a foreign substance in the intestines, either irritating mechanically or by its chemical properties, and which the diarrhœa serves to remove.

The danger arises from complications, as spurious hydrocephalus, or from the emaciation and exhaustion, or from its eventuating in inflammation.

If the rotundity of the figure and firmness of the tissues be preserved, showing that alimentation is still sufficient, and no complication arise, the diarrhœa is not as a rule dangerous. In infants that over-nurse and do not vomit the surplus milk, the evacuations are sometimes green and frequent, and yet fulness of figure is preserved, and the development of the body proceeds as usual. On the other hand, diarrhœa attended by emaciation or softness or flabbiness of the flesh, involves danger, and requires immediate treatment.

Treatment.—It is necessary, in order to treat diarrhœa in infancy and childhood successfully, to ascertain the cause, and, so far as possible, to remove it. It is not till the cause ceases to operate, that we can expect a satisfactory result from medication. The disease may be temporarily relieved by medicine, but it usually returns at once when treatment is omitted, unless the patient be removed from the influence of the agencies which produce it. These remarks are especially applicable to the diarrhœa of infants. With them very generally, when affected with this complaint, there is some fault as regards the quantity or quality of food. Attention to this matter will show the need of a change of wet-nurse, or, if the infant be spoon-fed, a change in the character of its food or in the mode of preparation or even in the quantity given. Sometimes by change in the diet, and the adoption of hygienic measures, the complaint ceases, so as to require no medication. If medicines be needed, and the symptoms are not urgent, it is occasionally advantageous to commence treatment by the use of some of the milder purgatives in small doses. In the *infant*, in whom the dejections are so generally acid, an alkaline laxative, or a laxative conjoined with an alkali, often has a good effect as preliminary treatment. Half a teaspoonful to one teaspoonful of castor oil, or a proportionate dose of calcined magnesia,

removes any acid or irritating substance from the intestines, and is followed by a diminution in the number of stools. The improvement, however, without subsequent treatment, is usually only for a day or two. In this city a purgative dose of castor oil is often given as a domestic remedy in infantile diarrhœa, the beneficial effect from it having popularized its use for this purpose. Trousseau usually gave Rochelle salts, but this medicine is too severe and dangerous for the treatment of infantile diarrhœa, especially in warm months.

If there have been previous constipation, and the diarrhœa have just commenced, a purgative is obviously indicated. West says: "Provided there be neither much pain nor much tenesmus, and the evacuations, though watery, are fecal, and contain little mucus and no blood, very small doses of the sulphate of magnesia and tincture of rhubarb have seemed to me more useful than any other remedy:

℞.—Magnesiæ sulphatis . . . . . ʒj.
Tinct. rhei . . . . . ʒj.
Syr. zingiberis . . . . . ʒj.
Aquæ carui . . . . . ʒix.—Misce.
ʒj ter die for children one year old;

and I seldom fail to observe from it a speedy diminution in the frequency of the action of the bowels, and a return of the natural character of the evacuations."

In diarrhœa of infants, due to indigestion, and attended by acidity, the following prescription is sometimes useful. By improving digestion and correcting acidity, it has a beneficial effect on the diarrhœa. The cases are, however, in my experience exceptional in which this is the proper remedy:

℞.—Pulv. ipecacuanhæ . . . . . gr. ss.
Pulv. rhei . . . . . gr. ij.
Sodæ bicarb. . . . . gr. xij.—Misce.
Divide in chart. No. xii. One powder every four to six hours to an infant one year old.

The effect of laxative medicines, employed for the purpose of correcting the functions of the gastro-intestinal surface, is uncertain. If no improvement results from their use within two or three days, they should be omitted. We must rely on astringents, opiates, and, in infants, also on alkalies. If the symptoms be urgent, if the evacuations be frequent and exhausting, these agents should be employed from the first. Much harm is often done, and precious time lost, by prescribing laxative mixtures when opiates and astringents are required. I have know them to aggravate the complaint, when, by change of measures, immediate improvement followed. The majority of cases of non-inflammatory diarrhœa, at the period when the physician is called, are best treated by the use of astringents and opiates exclusively, proper directions at the same time being given in reference to the diet and hygienic management.

In the diarrhœa of infants the compound powder of chalk and opium is an excellent medicine, containing, as it does, an astringent with the opiate and alkali. It may be given in doses of three grains, to a child

one year old, every three hours. I ordinarily employ it with double its quantity of subnitrate of bismuth, and know no better remedy for ordinary cases. The following is a convenient formula for administering substantially the same medicines in the liquid form:

℞.—Tinct. opii deodorat. . . . . gtt. xvj.
Bismuth. subnitrat. . . . . ʒij.
Syr. simplic. . . . . ʒss.
Mistur. cretæ . . . . . ʒiss.—Misce.
Shake well and give one teaspoonful from three to four hours.

In a large majority of cases I employ this prescription, or one similar to it, from my first visit. If the patient be not relieved by the opiate, alkali, and bismuth, and by proper regimen, in all probability inflammation of the intestinal mucous membrane is present. In patients over the age of two or three years simple diarrhœa approaches in character that of the adult, and the treatment appropriate for the adult is proper in these cases, allowance being made for the difference in age. In infants, in whom this disease, if protracted, is very liable to eventuate in spurious hydrocephalus, alcoholic stimulants are often required at an early period, on account of the prostration and feeble power of endurance.

CHAPTER VIII.

INTESTINAL CATARRH OF INFANCY (ENTERO-COLITIS).

It is customary with writers to treat of inflammation of the small and large intestines in infancy as a single disease, for the following reasons: First, the symptoms of colitis at this period of life do not ordinarily differ, in any marked degree, from those of enteritis. The tormina, tenesmus, and abdominal tenderness, which characterize colitis in childhood and adult life, are ordinarily lacking, or are not appreciable by the observer; and the muco-sanguineous evacuations are oftener absent than present. On account of this absence of symptoms, Bouchut says: "Dysentery is a very rare disease among young children. Its existence might even be denied, if it had not been observed at the period of some severe epidemics of dysentery." If Bouchut refers, by the term dysentery, to the ordinary phenomena of that disease, his remark is correct; but, as regards the lesions, it is erroneous, for colitis is a common infantile malady. Billard, after analyzing eighty cases of intestinal inflammation in infants, says: "From this calculation, it is evidently very difficult to make a correct diagnosis of inflammation of the intestinal tube in sucking infants, yet it would seem as if the proper signs of enteritis or ileitis were the rapid tympanitis of the abdomen, the diarrhœa, accompanied with vomiting; while in colitis, diarrhœa

alone, without tympanitis, is the most frequent." And again: "In consequence of the impossibility we have found to exist of tracing with exactitude the series of symptoms proper to inflammation of the different portions of the digestive tube, we shall content ourselves with presenting an analytical sketch of the causes, symptoms, and ordinary course of inflammation of the mucous membrane of the intestines in general."

The frequent absence of any pathognomonic symptom or sign, by which to determine the exact seat of intestinal inflammation in the infant, is admitted by recent observers as well as Billard.

The second reason why intestinal inflammation in the infant is described as a single disease is, that enteritis and colitis, in the majority of cases, coexist. This will be seen when we come to speak of the anatomical characters.

In rural districts infantile diarrhœa is not so prevalent and fatal as in cities. In the farming sections it does not materially increase the death-rate, and it is, therefore, not so important a malady as in cities. In cities it largely increases the aggregate of deaths. Especially fatal is that form of it which is known as the summer epidemic, as is seen by the mortuary records of any large city. Thus in New York City during 1882 the deaths from diarrhœa reported to the Health Board, tabulated in months, were as follows:

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Under five years .	34	32	50	50	72	231	1533	817	362	195	68	35
Over five years .	14	15	14	20	15	19	131	149	84	55	31	24

It is seen that in 1882 in New York City, the deaths from diarrhœa under the age of five years were greatly in excess of the number during the whole period of life subsequently to that age.

The following statistics show how great a destruction of life this malady causes even under the surveillance of an energetic health board; and before this board was established it was much greater, as I had abundant opportunities to observe. The last annual report of the New York Board of Health was made in 1875, since which time weekly bulletins have been issued. The deaths from diarrhæa at all ages in the last three years in which annual reports were issued were as follows:

	1873.	1874.	1875.
January	94	43	46
February	84	34	52
March	93	40	58
April	114	47	45
May	95	61	89
June	220	144	157
July	1514	1205	1387
August	967	1007	1012
September	424	587	608
October	213	255	185
November	87	105	57
December	53	56	50

In their annual report for 1870 the Board state: "The mortality from the diarrhœal affections amounted to 2789, or 33 per cent. of the

total deaths; and of these deaths 95 per cent. occurred in children less than five years old, 92 per cent. in children less than two years old, and 67 per cent. in those less than a year old." Every year the reports of the Health Board furnish similar statistics, but enough have been given to show how great a sacrifice of life infantile diarrhœa produces annually in this city.

What we observe in New York in reference to this disease is true also, to a greater or less extent, in other cities of this country and Europe, so far as we have reports. Not in every city is there the same proportionate mortality from this cause as in New York, but the frequency of infantile diarrhœa and the mortality which attends it render it an important disease in, I believe, most cities of both continents. In country towns, whether in villages or farm-houses, this disease is comparatively unimportant, inasmuch as few cases occur in them, and the few that do occur are of mild type, and consequently much less fatal than in cities.

The comparative immunity of rural districts has an important relation, as we will see, to the hygienic management of these cases.

Etiology.—The diarrhœa of infants is occasionally produced by taking cold. Infants insufficiently protected by clothing, and exposed to sudden changes of temperature, or to currents of air in the apartments where they reside, or heedlessly exposed outdoor by careless nurses, sometimes become affected with diarrhœa, even of a fatal character. They contract an intestinal inflammation from taking cold, just as other infants may contract coryza or bronchitis from the same cause.

But the most common causes of infantile diarrhœa are, first, the use of food which is unsuitable for infantile digestion, and which, therefore, acts as an irritant; and, secondly, residence in a foul atmosphere, to which we will soon call attention, and which largely increases the percentage of deaths in our cities during the hot months. Diarrhœa due to taking cold occurs in all localities and climates, but it is obviously most common in times of changeable weather. That due to the use of unsuitable food and foul air, occurs for the most part in cities, and much more frequently in the summer season than in the cool months, as the above statistics show. Infantile intestinal catarrh, however produced, presents nearly the same anatomical characters, so that, whatever its etiology, it is proper to describe it as one disease, but that form of it which requires most elucidation, and the causes of which we will consider in the following pages, is that produced by impure air and improper diet.

The prevalence and severity of infantile diarrhœa in cities, correspond closely with the degree of atmospheric heat, as may be inferred from the foregoing statistics. In New York this disease begins in the month of May—earlier in some years than in others—in a few scattered cases, commonly of a mild type. Cases become more and more numerous and severe as the weather grows warmer until July and August, when the diarrhœa attains its maximum prevalence and severity. In these two months it is by far the most frequent and fatal of all the diseases in cities. In the middle of September new patients begin to be less common, and in the latter part of this month and subsequently new

cases do not occur, unless under unusual circumstances which favor the development of this malady. In New York a considerable number of deaths of infants occur from diarrhœa in October. October is not a hot month in our latitude—its average temperature is lower than that of May—and yet the mortality from this disease is considerably larger in the former than in the latter month. This fact, which seems to show that the prevalence of the summer diarrhœa does not correspond with the degree of atmospheric heat, is readily explained. The mortality in October, and indeed in the latter part of September, is not that of new cases, but is mainly of infants, as I have observed every year, who contract the disease in July or August or earlier, and linger in a state of emaciation and increasing weakness till they finally succumb, some even in cool weather.

The fact is therefore undisputed, and is universally admitted, that the summer season, stated in a general way, is the cause of this annually recurring diarrhœal epidemic, but it is not so easy to determine what are the exact causative conditions or agents which the summer weather brings into activity. That atmospheric heat does not in itself cause the diarrhœa is evident from the fact that in rural districts there is the same intensity of heat as in cities, and yet the summer complaint does not occur. The cause must be looked for in the state of the atmosphere engendered by heat where unsanitary conditions exist, as in large cities. Moreover, observations show that the noxious effluvia with which the air becomes polluted under such circumstances constitute or contain the morbific agent. Thus, in one of the institutions of this city a few years since, on May 10, which happened to be an unusually warm day for this month, an offensive odor was noticed in the wards, which was traced to a large manure-heap that was being upturned in an adjacent garden. On this day four young children were severely attacked by diarrhœa, and one died. Many other examples might be cited showing how the foul air of the city during the hot months, when animal and vegetable decomposition is most active, causes diarrhœa. Several years since, while serving as sanitary inspector for the Citizens' Association in one of the city districts, my attention was particularly called to one of the streets, in which a house-to-house visitation disclosed the fact that nearly every infant between two avenues had diarrhœa, and usually in a severe form, not a few dying. This street was compactly built with wooden tenement-houses on each side, and contained a dense population, mainly foreigners, poor, ignorant, and filthy in their habits. It had no sewer, and the refuse of the kitchens and bed-chambers was thrown into the street, where it accumulated in heaps. Water trickled down over the sidewalks from the houses into the gutters or was thrown out as slops, so that it kept up a constant moisture of the refuse matter which covered the street, and promoted the decay of the animal and vegetable substances which it contained. The air in the domiciles and street under such conditions of impurity was necessarily foul in the extreme, and stifling during the hot days and nights of July and August; and it was evidently the important factor in producing the numerous and severe diarrhœal cases which were in these domiciles.

In another locality, occupied by tripe-dealers and a low class of

butchers who carried on fat- and bone-boiling at night, the air was so foul after dark that the peculiar impurity which tainted it could be distinctly noticed in the mouth for a considerable time after a night visit. In the street where these nuisances existed and in adjacent streets the summer diarrhœa was very prevalent and destructive to human life. Murchison states that twenty out of twenty-five boys were affected with purging and vomiting from inhaling the effluvia from the contents of an old drain near their school-room. Physicians are familiar with a similar fact showing this purgative effect of impure air—that the atmosphere of a dissecting-room often causes diarrhœa in those otherwise healthy.

The exact nature of the deleterious agent or agents in foul air which cause the diarrhœa, whether they be gases or organisms, has not been fully determined; but at a recent meeting of the Berliner Med. Gesellschaft, A. Baginsky made a report on the bacilli of cholera infantum, which he states he has found both in the dejections and in the intestinal mucous membrane in the bodies of those who have perished with this disease. In the stools, along with numerous other organisms, Baginsky states that he found masses of zoöglœa, and the same organisms he detected on the surface of the small intestines, and could trace their wanderings as far as the submucous tissue.[1] But it is evidently very difficult to determine whether such organisms sustain a causative relation to diarrhœa or spring into existence in consequence of the foul secretions and decomposing fecal matters which are present.

The impurities in the air of a large city are very numerous. Among those of a gaseous nature are sulphurous acid, sulphuric acid, sulphuretted hydrogen; various gases of the carbon group, as carbonic acid, carburetted hydrogen, and carbonic oxide; gases of the nitrogen group, as the acetate, sulphide, and carbonate of ammonium, nitrous and nitric acids; and at times compounds of phosphorus and chlorine (Parkes). A theory deserving consideration is that certain gaseous impurities found in the air form purgative combinations. D. F. Lincoln, in his interesting paper on the atmosphere in the *Cyclopœdia of Medicine*, writes in regard to sulphuretted hydrogen: "When in the air, freely exposed to the contact of oxygen, it becomes sulphuric acid. Sulphide of ammonium in the same circumstances becomes a sulphate, which, encountering common salt (chloride of sodium), produces sulphate of sodium and chloride of ammonium. The sulphates form a characteristic ingredient of the air in manufacturing districts." The sulphates, we know, are for the most part purgatives, but whether they or other chemical agents exist in the respired air in sufficient quantity to disturb the action of the intestines, even where atmospheric impurities are most abundant, is problematical and uncertain.

Again, the solid impurities in the air of a large city are very numerous, as any one may observe by viewing a sunbeam in a darkened room, which is made visible by the numerous particles floating in it. These particles consist largely of organic matter, which sometimes has been carried a long distance by the wind. The remarkable statement has been made that in the air of Berlin organic forms have been found of

[1] Allegem. Wien. Mediz. Zeitung, Nov. 6, 1883.

African production. Ehrenberg discovered fragments of insects of various kinds—rhizopods, tardigrades, polygastrics, etc.—which, existing in considerable quantity and inhaled in hot weather, when decomposition and fermentation are most active, may be deleterious to the system. Monads, bacteria, vibriones, amorphous dust containing spores which retain their vitality for months, are among the substances found in the air of cities. The well-known hazy appearance of the atmosphere resting over a large city like New York when viewed from a distance is due to the gaseous and solid impurities with which the air is so abundantly supplied—impurities which assume importance in pathological studies, since minute organisms are now believed to cause so many diseases the etiology of which has heretofore been obscure. With our present knowledge we must be content with the general statement that impure air is one of the two important factors which cause summer diarrhœa, without being able to state positively which of the elements in the air are most instrumental in causing this result. But the theory is plausible that minute organisms rather than chemical products are the chief cause. Henoch, of Berlin, writing upon this subject, calls attention to the disease known as intestinal mycosis, its prominent symptom being a severe diarrhœa produced by eating diseased meat containing a fungus. He believes that "a portion of the fungus not destroyed by the gastric juice settles upon different parts of the intestine, and there produces its effects;" and he adds, "At present, however, we can regard the mykotic theory of cholera infantum only as a very probable hypothesis. There is no doubt that high atmospheric temperature increases the tendency to fermentation dyspepsias which is present in imperfectly nourished children at all seasons, and causes them to appear not only epidemically, but also in an extremely acute form which is not frequent under ordinary circumstances. This would lead to the conclusion that. in addition to the heat, infectious germs are present, which, being developed in great masses by the former, enter the stomach with the food." The fungus theory of the causative relation of atmospheric heat to the diarrhœa of the summer season, as thus explained by Henoch, commands the readier assent since it comports with the well-known facts relating to the etiology of the summer complaint. This disease, as we have seen, is most prevalent and fatal under precisely those conditions of dense population, filthy domiciles and streets, and atmospheric heat which are favorable for the development of low organisms.

In those portions of our cities which are occupied by the poor, more than anywhere else, those conditions prevail which render the atmosphere deleterious. One accustomed to the pure air of the country would scarcely believe how stifling and poisonous the atmosphere becomes during the hot summer days and close summer nights in and around the domiciles in the poor quarters of the city. Among the causes of this foul air may be mentioned too dense a population, the occupancy of small rooms by large families, rigid economy and ceaseless endeavor to make ends meet, so that in the absorbing interest sanitary requirements are sadly neglected. Adults of such families, and children of both sexes as soon as they are old enough, engage in laborious and often filthy occupations. Many of them seldom bathe, and they often wear

for days the same undergarments, foul with perspiration and dirt. The intemperate, vicious, and indolent, who always abound in the quarters of the city poor, are notoriously filthy in their habits and add to the insalubrity by their presence. Children old enough to be in the streets and adults away at their occupations escape to a great extent the evil effects of impure air, but the infantile population always suffer severely.

Every physician who has witnessed the summer diarrhœa of infants is aware of the fact that the mode of feeding has much to do with its occurrence. A large proportion of those who each summer fall victims to it would doubtless escape if the feeding were exactly proper. In New York City facts like the following are of common occurrence in the practice of all physicians: Infants under the age of eight months, if bottle-fed, nearly always contract diarrhœa, and usually of an obstinate character, during the summer months. The younger the infant, the less able is it to digest any other food than breast-milk, and the more liable is it therefore to suffer from diarrhœa if bottle-fed. In the institutions nearly every bottle-fed infant under the age of four or even six months dies in the hot months with symptoms of indigestion and intestinal catarrh, while the wet-nursed of the same ages remain well. Sudden weaning, the sudden substitution of cow's milk or any artificially prepared food in place of breast-milk in hot weather, almost always produces diarrhœa, often of a severe and fatal nature. Feeding an infant in the hot months with indigestible and improper food, as fruits with seeds or the ordinary table food prepared in such a way that it overtaxes the digestive function of the infant, causes diarrhœa, and not infrequently that severe form of it which will be described under the term cholera infantum. Many obstinate cases of the summer complaint begin to improve under change of diet, as by the substitution of one kind of milk for another or the return of the infant to the breast after it has been temporarily withdrawn from it. It is a common remark in the families of the city poor that the second summer is the period of greatest danger to infants. This increased liability of infants to contract diarrhœa in the second summer is due to the fact that most infants in their second year are table-fed, while in the first year they are wet-nursed. Such facts, with which all physicians are familiar, show how important the diet is as a factor in causing the summer complaint.

Occasionally, from continued ill-health, the milk of the mother or wet-nurse does not agree with the nursling. Examined with the microscope, it is found to contain colostrum. Under such circumstances if a healthy wet-nurse be employed the diarrhœa ceases. It is very important that any woman furnishing breast-milk to an infant should lead a quiet and regular life, with regular meals and sleep. R. B. Gilbert[1] relates striking cases in which venereal excesses on the part of wet-nurses were immediately followed by fatal diarrhœa in the infants which they suckled.

One not a resident would scarcely be able to appreciate the difficulty which is experienced in a large city in obtaining proper diet for young

[1] Louisville Med. Journal, Aug. 19, 1882.

children, especially those of such an age that they require milk as the basis of their food. Milk from cows stabled in the city or having a limited pasturage near the city, and fed upon a mixture of hay with garden and distillery products, the latter often largely predominating, is unsuitable. It is deficient in nutritive properties, prone to fermentation, and from microscopical and chemical examinations which have been made it appears that it often contains deleterious ingredients. If milk be obtained from distant farms where pasturage is fresh and abundant—and in New York City this is the usual source of the supply—considerable time elapses before it is served to customers, so that, particularly in the hot months of July and August, it frequently has begun to undergo lactic acid fermentation when the infants receive it. That dispensed to families in the morning is the milking of the previous morning and evening. The use of this milk in midsummer by infants under the age of ten months frequently gives rise to more or less diarrhœa.

The ill-success of feeding with cow's milk has led to the preparation of various kinds of food which the shops contain, but no dietetic preparation has yet appeared which agrees so well with the digestive function of the infant as breast-milk, and is at the same time sufficiently nutritive.

In New York City improper diet, unaided by the conditions which hot weather produces, is a common cause of diarrhœa in young infants, for at all seasons we meet with this diarrhœa in infants who are bottle-fed; but when the atmospheric conditions of hot weather and the use of food unsuitable for the age of the infant are both present and operative, this diarrhœa so increases in frequency and severity that it is proper to designate it the summer epidemic of the cities. Several years since, before the New York Foundling Asylum was established, the foundlings of New York, more than a thousand annually, were taken to the almshouse on Blackwell's Island and consigned to the care of pauper-women, who were mostly old, infirm, and filthy in their habits and apparel. Their beds, in which the foundlings were also placed alongside of them, were seldom clean, not properly aired and washed, and under the beds were various garments and utensils which these pauper-women had brought with them as their sole property from their miserable abodes in the city. With such surroundings, the air which these infants breathed day and night manifestly contained poisonous emanations; while their diet was equally improper, for it was prepared by these women from such milk and farinaceous food as were furnished the almshouse. When assigned to duty in the almshouse, this service being at that time a branch of Charity Hospital, I was informed that all the foundlings died before the age of two months; one only was pointed out as a curiosity which had been an exception to the rule. The disease of which they perished was diarrhœa, and this malady in the summer months was especially severe and rapidly fatal. The unpleasant experiences in this institution furnished additional evidence, were any wanting, that foul air and improper diet are the two important factors in causing the summer diarrhœa of infants. Since that beneficial charity, the New York Foundling Asylum, in East Sixty-eighth Street, came into exist-

ence, providing pure air and, for a considerable proportion of the foundlings, breast-milk, many of these waifs have been rescued from death.

Age.—Age is a predisposing cause of diarrhœa, since most cases occur under the age of three years. A large majority of the summer diarrhœas of the cities occur under the age of two years. The following table embraces all the cases that came to one of the city dispensaries during my service between the months of May and October, inclusive:

Age.	Cases.
5 months or under	58
5 months to 12 months	212
12 months to 18 months	174
18 months to 24 months	93
24 months to 36 months	36
Total	573

Dentition.—Statistics show that by far the largest number of cases occur during the period of first dentition; hence the prevalent opinion among families that dentition causes the diarrhœa. It is the common belief among the poor of New York that diarrhœa occurring during dentition is conservative, and should not be checked. They believe that an infant cutting its teeth suffers less, and may be saved from serious illness, if it have frequent stools. Every summer I see infants reduced to a state of imminent danger through the continuance of diarrhœa during several weeks, nothing having been done to check it in consequence of this absurd belief. The progressive loss of flesh and strength and wasting of the features do not excite alarm, under the blinding influence of this theory, till the diarrhœa has continued so long and become so severe that it is with difficulty controlled, and the patient is in a state of real danger when the physician is first summoned. The following statistics, which comprise cases occurring during my service in one of the city dispensaries, show the preponderance of cases during the age when dental evolution is occurring:

	Cases.
No teeth and no marked turgescence of gums	47
Cutting incisors	106
Cutting anterior molars	41
Cutting canines	40
Cutting last molars	20
All the teeth cut	28
Total.	282

It so happens that the period of dental evolution corresponds with that of the most rapid development and the greatest functional activity of the gastric and intestinal follicles, and the predisposition which exists to diarrhœal maladies at this age must be attributed to this cause rather than to dentition.

Symptoms.—The intestinal catarrh of infancy commonly begins gradually with languor, fretfulness, and slight febrile movement. The diarrhœa at first usually attracts little attention from its mildness. The stools, while they are thinner than natural, vary in appearance, being yellow, brown, or green. Infants with milk diet usually pass green

and acid stools containing particles of undigested casein. The tongue in the commencement of the attack is moist and covered with a slight fur. At a more advanced stage it may be moist, but is often dry, and in dangerous forms of the malady, accompanied by prostration, the buccal surface is red and the gums more or less swollen and sometimes ulcerated. Vomiting is common. It may commence simultaneously with the diarrhœa, especially when food that is unusually indigestible and irritating to the stomach has been given, but more frequently this symptom does not appear until the diarrhœa has continued a few days. I preserved memoranda of the date when vomiting began in the cases treated in two consecutive years, and found that ordinarily it was toward the close of the first week. When it is an early and prominent symptom it appears to be due to the presence in the stomach of imperfectly digested or fermented and acid food, which, when ejected, gives a decidedly acid reaction with appropriate tests. It contains coagulated casein and undigested particles of whatever food has been given. In many patients the progressive loss of flesh and strength is largely due to the indigestion and vomiting by which the food, which is so much required for proper nourishment, is lost.

Emesis occurring at a late stage of infantile diarrhœa is often due to commencing spurious hydrocephalus, which is not an infrequent complication, as we will see, of protracted cases. Perhaps when a late symptom it may sometimes have an uræmic origin, for the urine is usually quite scanty in advanced cases. It seems probable, however, that deleterious effects from non-elimination of urea are to a considerable extent prevented by the diarrhœa.

The fecal evacuations may remain nearly uniform in appearance during the disease, but in many patients they vary in color and consistence at different periods. In the same case they may be brown and offensive at one time, green at another, and again they may contain masses of a putty-like appearance, the partly digested casein or altered epithelial cells. The stools sometimes consist largely of mucus, with or without occasional streaks of blood, indicating the predominance of inflammation in the colon. This is the mucous diarrhœa of Barrier. The stools are sometimes yellow when passed, but become green on exposure to the air from chemical reaction due to admixture with the urine.

The character of the alvine discharges is interesting. In addition to undigested casein I have found epithelial cells, single or in clusters (sometimes regularly arranged as if detached in mass from the villi), fibres of meat, crystalline formations, mucus, and occasionally blood, as stated above. In one instance I observed an appearance resembling three or four crypts of Lieberkühn united, probably thrown off by ulceration. If the stools are green, colored masses of various sizes, but mostly small, are also seen under the microscope.

The pulse is accelerated according to the severity of the attack. The heat of the surface is at first generally increased, though but slightly in ordinary cases; but when the vital powers begin to fail from the continuance of the diarrhœa the warmth of the surface diminishes. In advanced cases approaching a fatal termination the face and extremities are pallid and cool, and the pulse gradually becomes more frequent and

feeble. The skin is usually dry, and, as already stated, the urinary secretion diminished. In severe cases attended by frequent alvine discharges the infant does not pass urine oftener than once or twice daily. The imperfect action of the skin and kidneys is noteworthy.

Protracted cases of diarrhœa are frequently complicated by two cutaneous eruptions—erythema extending over the perineum and frequently as far as the thighs and lower part of the abdomen, due to the acid and irritating character of the stools; and boils upon the forehead and scalp. The latter sometimes extend to the pericranium, and in case of recovery leave permanent cicatrices. This furuncular affection of the scalp has seemed to me useful in consequence of the external irritation which it causes, since it occurs at a time when, on account of the feeble heart's action and languid circulation, passive congestion of the vessels of the brain and meninges is liable to be present.

Patients who are weak and wasted in consequence of protracted diarrhœa, remaining almost constantly in the recumbent position, often have an occasional dry cough which continues till the close of life. It is due to hypostatic congestion in the lungs, usually limited to the posterior and inferior portions of the lobes, extending but a little way into the lungs. It is the result of prolonged recumbency with feeble heart's action and feeble pulmonary circulation. Infants reduced by chronic diseases, lying day after day in their cribs with little movement of their bodies, are very liable to this passive congestion of depending portions of their lungs, toward which the blood gravitates, and into which but little air enters in consequence of their distance and position and the feeble respirations. The hyperæmia which results is of a passive character, a venous congestion, and the affected lobules have a dusky-red color. This congestion, continuing, soon results in pneumonitis of the catarrhal form, subacute and of a low grade, for pulmonary lobules in which the blood remains stagnant soon exhibit augmented cell-proliferation, perhaps from the irritating effects of the elements of the blood now withdrawn from the circulation.

I have made or procured a considerable number of microscopic examinations in these cases of hypostatic pneumonia, and the solidification of the pulmonary lobules has been found to be due to the exaggerated development of the epithelial cells in the alveoli, together with venous congestion. The affected lobules, whether in a stage of hypostatic congestion or the more advanced stage of hypostatic pneumonitis, when examined at the autopsy, were somewhat softer than in health, of dark color, and many of the lobules could be inflated by strong force of the breath; but in protracted cases the alveoli in central parts of the inflamed area resisted insufflation. The lung in hypostatic pneumonia, even when it is inflated, still feels firmer between the fingers than the normal lung.

Hypostatic pneumonia is so common in hospitals for infants that some physicians whose observations have been chiefly in such institutions have almost ignored other forms of pulmonary inflammation. Billard, many years ago, wrote: "... The pneumonia of young children is evidently the result of stagnation of blood in their lungs. Under these circumstances the blood may be regarded as a kind of

foreign body." Of all the chronic and exhausting diseases of infancy, no one has, according to my observations, been so frequently complicated by hypostatic pneumonia as the disease which we are considering, although it does not usually give rise to any more prominent symptom than an occasional cough. Limited to a small and almost immovable part of the lung, it does not ordinarily accelerate respiration or render it painful, and the cough is also apparently painless.

When progressive loss of flesh and strength has continued several weeks, and the patient is much exhausted, another complication is liable to occur, known as spurious hydrocephalus or the hydrocephaloid disease, the anatomical characters of which will be described in the proper place. The commencement of spurious hydrocephalus is announced by gradually increasing drowsiness, perhaps preceded by a period of unusual fretfulness. Vomiting and rolling the head are occasional early symptoms of this complication. As the drowsiness increases the pupils become less sensitive to light than in their normal state, and are usually contracted. When the drowsiness becomes profound and constant, the pupils remain contracted as in sound sleep or in opium narcotism. The functional activity of the organs is now also diminished, the vomiting ceases, the stools become less frequent, the buccal surface dry, and the urine scanty, while the pulse is frequent and feeble. Spurious hydrocephalus either continues till death, or by stimulation the patient may emerge from it. When profound the usual result is death.

Although infantile diarrhœa in its commencement may be promptly arrested by proper hygienic and medicinal treatment, if it continue a few weeks the anatomical changes which occur are such that recovery, if it take place, is necessarily slow and gradual. Improvement is shown by better digestion, fewer stools, and of better appearance, less frequent vomiting, a more cheerful countenance, and the absence of symptoms which indicate a complication. Many recover after days of anxious watching and perhaps after many fluctuations.

Death may occur early from a sudden aggravation of symptoms and rapid sinking, or the attack may be so violent from the first that the infant quickly succumbs; but more frequently death takes place after a prolonged sickness. Little by little the patient loses flesh and strength, till a state of marked emaciation is reached. The eyes and cheeks are sunken, the bony projections of the face, trunk, and limbs become prominent, and the skin lies in wrinkles from the wasting. The altered expression of the face makes the patient look older than the actual age. The joints in contrast with the wasted extremities seem enlarged and the fingers and toes elongated. The stools diminish in frequency from diminished peristaltic and vermicular action, and vomiting, if previously present, now ceases. A feeble, quick, and scarcely appreciable pulse, slow respiration, and diminished inflation of the lungs, sightless and contracted pupils, over which the eyelids no longer close, announce the near approach of death. The drowsiness increases and the limbs become cool, while perhaps the head is hot. The infant no longer has the ability to nurse, or if bottle-fed the food placed in the mouth flows back, or is swallowed with apparent indifference. So low is its vitality that it lies pallid and almost motionless for hours or even days before

death, and death occurs so quietly that the moment of its occurrence is scarcely appreciable.

Anatomical Characters.—Since the prominent and essential symptoms of the disease which we are considering pertain to the digestive apparatus, it is evident that the lesions which attend and characterize it are to be found in this part of the system. Lesions elsewhere, so far as they are appreciable to us, are secondary and not essential. I have witnessed a large number of autopsies of infants who have perished from diarrhœa, chiefly in institutions, and they have been sufficiently marked and uniform to enable us to designate it an entero-colitis. Several years since I preserved records of the autopsical appearances in the intestinal catarrh of infants, most of the cases being of summer diarrhœa. The number aggregated eighty-two. Since then I have witnessed many autopsies in institutions in cases of this disease, and the lesions observed were similar to those in the eighty-two cases.

The question may properly be asked, Can inflammatory hyperæmia of the intestinal mucous membrane be distinguished from simple congestion if there be no ulceration and no appreciable thickening of the intestine? It is possible that occasionally I have recorded as inflammatory what was simply a congestive lesion, but I do not think I have incorporated a sufficient number of such cases to vitiate the statistics. In a large proportion of the cases there was evident thickening of the intestinal mucous membrane or other unequivocal evidence of inflammation. The following is an analysis of the eighty-two cases:

The duodenum and jejunum presented the appearance of inflammatory hyperæmia in 12 cases. The hyperæmia was usually in patches of variable extent or of that form described by the term arborescent. In 51 cases the duodenal and jejunal mucous membrane was pale and without any other appearance characteristic of catarrh or inflammation. In the remaining 19 cases the appearance of the duodenum and jejunum was not recorded, so that it was probably normal. On the other hand, in the ileum inflammatory lesions were present as a rule. In 49 cases I found the surface of the ileum distinctly hyperæmic, and in that portion of it nearest the ileo-cæcal valve, including the valve itself, the inflammation had evidently been the most intense, since in this portion the hyperæmia and thickening of the mucous membrane were most marked. In 16 cases the surface of the ileum appeared nearly or quite normal; in 14 hyperæmia in the small intestines in patches, streaks, or arborescence was recorded, but the records do not state in which division of the intestines they were observed.

Billard, with other observers, has noticed the frequency and intensity of the inflammatory lesions in entero-colitis in the terminal portion of the small intestines, and the thickening in many cases of the ileo-cæcal valve, and he asks whether the vomiting which is so common and often obstinate in this disease may not be sometimes due to obstruction to the passage of fecal matter at the valve in consequence of the hyperæmia and swelling, but has not observed any retained fecal matter above it, such as we find in any part of the colon, or any other appearance which indicated sufficient obstruction to cause symptoms. Still, it seems not

improbable that the reason why the inflammatory lesions are more pronounced at and immediately above the valve than in other parts of the small intestine is that the fecal matter, so commonly acid and irritating in this disease, is somewhat delayed in its passage downward at this point.

Small superficial circular or oval ulcers were observed in the ileum in 4 cases, in 2 of which they were found also in the lower part of the jejunum. In 1 case the records state that ulcers were in the jejunum, but do not mention whether they were also in the ileum. In 1 case, in which there was much thickening of the ileum next to the ileo-cæcal valve, many small granulations had sprouted up from the submucous connective tissue, so that the mucous surface appeared as if studded with small warts.

Softening of the mucous membrane was also apparent in certain cases. The firmness of its attachment to the parts underneath varied considerably in different specimens. I was able in cases in which there was considerable softening to detach readily the mucous membrane with the nail or handle of the scalpel within so short a period after death that it was probable that the change of consistence was not cadaveric. In some cases the vessels of the submucous tissue were injected and this tissue infiltrated.

In all the cases except one lesions were present indicating inflammation of the mucous membrane of the colon. In 39 hyperæmia, thickening, and other signs of inflammation extended over nearly or quite the entire colon; in 14 the colitis was confined to the descending portion entirely or almost entirely; in 28 cases the records state that inflammatory lesions were found in the colon, but their exact location is not mentioned. In 18 of the autopsies the mucous membrane of the colon was found ulcerated.

Therefore, according to these statistics—and autopsies which I have witnessed that are not embraced in them disclosed similar lesions—colitis is present, almost without exception, in cases of summer diarrhœa, associated with more or less ileitis. The portion of the colon which presents the most marked inflammatory lesions is that in and immediately above the sigmoid flexure—that portion, therefore, in which any fermenting fecal matter has reached its greatest degree of fermentation, and consequently contains the most irritating elements, and where, next to the caput coli, it is longest delayed in its passage downward.

The solitary glands of both the large and small intestines and Peyer's patches undergo hyperplasia. In cases of short duration, and in parts of the intestine where the inflammatory action has been mild, the solitary glands present a vascular appearance, like the surrounding membrane, and are slightly enlarged. The enlargement is most apparent if the intestine be viewed by transmitted light, when not only are the glands seen to be swollen, but their central dark points are distinct. If a higher grade of intestinal catarrh or a catarrh more protracted have occurred, the volume of these follicles is so increased that they rise above the common level and present a papillary appearance. Peyer's patches are also distinct and punctate. The enlargement of Peyer's

patches, like that of the solitary glands, is due to hyperplasia, the elementary cells being largely increased in number.

The small ulcers which, as we have seen from the above statistics, are present in a certain proportion of cases in the mucous membrane of the colon, and more rarely in that of the small intestine when the inflammation has been protracted and of a severe type, appear to occur in the solitary glands and in the mucous membrane surrounding them. While some of these glands in a specimen are simply tumefied, others are slightly ulcerated, and others still nearly or quite destroyed. The ulcers are usually from one to three lines in diameter, circular or oval, with edges slightly raised from infiltration. Rarely, I have seen minute coagula of blood in one or more ulcers, and I have also observed ulcers which have evidently been larger and have partially healed. The ulcers are more frequently found in the descending colon than in other portions of the intestines. When ulcers are present they commonly occur in the descending colon, or if occurring elsewhere they are most abundant in this situation.

According to my observations, these ulcers are found chiefly in infants over the age of six months—during the time, therefore, when there is greatest functional activity and most rapid development of the solitary glands. Peyer's patches, though frequently prominent and distinct, have not been ulcerated in any of the cases observed by me.

The appendix vermiformis participates in the catarrh when it occurs in the caput coli, its mucous membrane being hyperæmic and thickened. In certain rare cases the inflammation is so intense that a thin film of fibrin is exuded in places upon the surface of the colon. It is liable to be overlooked or washed away in the examination. The rectum usually presents no inflammatory lesions, or but slight lesions in comparison with those in the colon. It remains of the normal pale color, or is but slightly vascular in most patients, even when there is almost general colitis. Hence the infrequency of tenesmus.

As might be expected from the nature of the disease, the secretion of mucus from the intestinal surface is augmented. It is often seen forming a layer upon the intestinal surface, and it appears in the stools mixed with epithelial cells and sometimes with blood and pus.

The mesenteric glands in cases which have run the most protracted course and ended fatally are found more or less enlarged from hyperplasia. They are frequently as large as a pea or larger, and of a light color, the color being due not only to the hyperplasia, but in part to the anæmia. Occasionally, when patients have been much reduced from the long continuance of the diarrhœa, and are in a state of marked cachexia before death, we find certain of these glands caseous.

The state of the stomach is interesting, since indigestion and vomiting are so commonly present. I have records of its appearance in 59 cases, in 42 of which it seemed normal, having the usual pale color and exhibiting only such changes as occur in the cadaver. In the remaining 17 cases the stomach was more or less hyperæmic, and in 3 of them points of ulceration were observed in the mucous membrane.

All physicians familiar with this disease have remarked the frequency of stomatitis. In protracted and grave cases it is a common

complication. The buccal surface in these cases is more vascular than natural, and if the vital powers are much reduced superficial ulcerations are not infrequent, oftener upon the gums than elsewhere. The gums are frequently spongy, more or less swollen, bleeding readily when rubbed or pressed upon. Thrush is a common complication of protracted diarrhœa in infants under the age of three or four months, but is infrequent in older infants. Occurring in those over the age of six or eight months, it has an unfavorable prognostic significance, indicating a form of diarrhœa which commonly eventuates in death.

The belief has long been prevalent in the past that the liver is also in fault. The green color of the stools was supposed to be due to vitiated bile. But usually in the post-mortem examinations which I have made I have found that the green coloration of the fecal matter did not appear at the point where the bile enters the intestines, but at some point below the ductus communis choledochus in the jejunum or ileum. The green tinge, at first slight, becomes more and more distinct on tracing it downward in the intestine. It appears to be due to admixture of the intestinal secretions with the fecal matter.

I have notes of the appearance and state of the liver in 32 fatal cases. Nothing could be seen in these examinations which indicated any anatomical change in this organ that could be attributed to the diarrhœal malady. The size and weight of the liver varied considerably in infants of the same age, but probably there was no greater difference than usually obtains among glandular organs in a state of health. The following was the weight of this organ in 20 cases:

Age.	Weight.	Age.	Weight.
4 weeks	5 ounces.	10 months	6¾ ounces.
2 months	3½ "	13 "	6 "
2 "	3½ "	14 "	9 "
4 "	5 "	15 "	6 "
5 "	6½ "	15 "	7½ "
5 "	9 "	15 "	9½ "
7 "	4½ "	16 "	6 "
7 "	6 "	19 "	4½ "
7 "	6¼ "	20 "	9¼ "
9 "	8 "	23 "	15 "

In none of these cases did the size, weight, or appearance of this organ seem to be different from that in health or in other diseases, except in one in which fatty degeneration had occurred, but this was probably due to tuberculosis, which was also present. In most of these cases the liver was examined microscopically, and the only noteworthy appearance observed was the variable amount of oil-globules in the hepatic cells. In some specimens the oil-globules were in excess, in others deficient, and in others still they were more abundant in one part of the organ than in another. Little importance was attached to these differences in the quantity of oily matter.

Hypostatic congestion of the posterior portions of the lungs, ending if it continue in a form of subacute catarrhal pneumonia and giving rise to an occasional painless cough, has been described in the preceding pages. The character of the cough in connection with the wasting might excite suspicions of the presence of tubercles in the lungs; but

tubercles are rare in this disease, and when present I should suspect a strong hereditary predisposition. They occurred in only 1 of the 82 cases.

The state of the encephalon in those patients in whom spurious hydrocephalus occurs is interesting. In protracted cases of diarrhœa the brain wastes like the body and limbs. In the young infant, in whom the cranial bones are still ununited, the occipital and sometimes the frontal bones become depressed and overlapped by the parietal, the depression being of course proportionate to the diminution in size of the encephalon. The cranium becomes quite uneven. In other children, with the cranial bones consolidated, serous effusion occurs according to the degree of waste, thus preserving the size of the encephalon. The effusion is chiefly external to the brain, lying over the convolutions from the base to the vertex. Its quantity varies from one or two drachms to an ounce or more. Along with this serous effusion, and antedating it, passive congestion of the cerebral veins and sinuses is also present. This congestion is the obvious and necessary result of the feebleness of the heart's action and the loss of brain substance.

Diagnosis.—In the adult abdominal tenderness is an important diagnostic symptom of intestinal catarrh, but in the infant this symptom is lacking or is not in general appreciable, so that it does not aid in diagnosis. When the diagnosis of the disease is established, the symptoms do not usually indicate what part of the intestinal surface is chiefly involved, but it may be assumed that it is the lower part of the ileum and the colon. The presence of mucus or of mucus tinged with blood in the stools shows the predominance of colitis.

Prognosis.—Although this disease largely increases the death-rate of young children, most cases can be cured if proper hygienic and medicinal measures be early applied. It is obvious, from what has been stated in the foregoing pages, that cholera infantum is the form of this malady which involves greatest danger. Except in such cases there is sufficient forewarning of a fatal result, for if death occur it is after a lingering sickness, with fluctuations and gradual loss of flesh and strength. Patients often recover from a state of great prostration and emaciation, provided that no fatal complications arise. The eyes may be sunken, the skin lie in folds from the wasting, the strength may be so exhausted that any other than the recumbent position is impossible, and yet the patient may recover by removal to the country, by change of weather, or by the use of better diet and remedies. Therefore an absolutely unfavorable prognosis should not be made except in cases that are complicated or that border on collapse. The most dangerous symptoms, except those which indicate commencing or actual collapse, arise from the state of the brain. Rolling the head, squinting, feeble action or permanent contraction of the pupils, spasmodic or irregular movements of the limbs, indicate the near approach of death, as do also coldness of face and extremities and inability to swallow. It is obvious also, in making the prognosis in ordinary cases, that we should consider the age of the patient, and if the diarrhœa be that of the summer season, the state of the weather, the time in the summer, whether in the beginning or near its close, and the surroundings, especially in reference to the impurity of the air, as well as the patient's condition.

Cholera Infantum, or Choleriform Diarrhœa.

This is the most severe form of infantile diarrhœa. It receives the name which designates it from the violence of its symptoms, which closely resemble those of Asiatic cholera. It is, however, quite distinct from that disease. It is characterized by frequent stools, vomiting, great elevation of temperature, and rapid and great emaciation and loss of strength. It commonly occurs under the age of two years. It sometimes begins abruptly, the previous health having been good; in other cases it is preceded by the ordinary form of diarrhœa. The stools have been thinner than natural and somewhat more frequent, but not such as to excite alarm, when suddenly they become more frequent and watery, and the parents are surprised and frightened by the rapid sinking and real danger of the infant.

The first evacuations, unless there have been previous diarrhœa, may contain fecal matter, but subsequently they are so thin that they soak into the diaper like urine, and in some cases they scarcely produce more of a stain than does this secretion. Their odor is peculiar—not fecal, but musty and offensive; occasionally they are almost odorless. Commencing simultaneously with the watery evacuations, or soon after, is another symptom, irritability of the stomach, which increases greatly the prostration and danger. Whatever drinks are swallowed by the infant are rejected immediately or after a few moments, or retching may occur without vomiting. The appetite is lost and the thirst is intense. Cold water is taken with avidity, and if the infant nurse, it eagerly seizes the breast in order to relieve the thirst. The tongue is moist at first, and clean or covered with a light fur, pulse accelerated, respiration either natural or somewhat increased in frequency, and the surface warm, but the temperature is speedily reduced in severe cases. The internal temperature or that of the blood is always very high. In ordinary cases of cholera infantum the thermometer introduced into the rectum rises to or above 105°, and I have seen it indicate 107°. Although the infant may be restless at first, it does not appear to have any abdominal pain or tenderness. The restlessness is apparently due to thirst or to that unpleasant sensation which the sick feel when the vital powers are rapidly reduced. The urine is scanty in proportion to the gravity of the attack, as it ordinarily is when the stools are frequent and watery.

The emaciation and loss of strength are more rapid than in any other disease which I can recall to mind, unless in Asiatic cholera. In a few hours the parents scarcely recognize in the changed and melancholy aspect of the infant any resemblance to the features which it exhibited a day or two before. The eyes are sunken, the eyelids and lips are permanently open from the feeble contractile power of the muscles which close them, while the loss of the fluids from the tissues and the emaciation are such that the bony angles become more prominent and the skin in places lies in folds.

As the disease approaches a fatal termination, which often occurs in two or three days, the infant remains quiet, not disturbed even by the

flies which alight upon its face. The limbs and face become cool, the eyes bleared, pupils contracted, and the urine scanty or suppressed. In some instances, when the patient is near death, the respiration becomes accelerated, either from the effect of the disease upon the respiratory centres or from pulmonary congestion resulting from the feeble circulation. As the vital powers fail the pulse becomes progressively more feeble, the surface has a clammy coldness, the contracted pupils no longer respond to light, and the stupor deepens, from which it is impossible to arouse the infant.

In the more favorable cases cholera infantum is checked before the occurrence of these grave symptoms, and often in cases which are ultimately fatal there is not such a speedy termination of the malady as is indicated in the above description. The choleriform diarrhœa abates and the case becomes one of ordinary summer complaint.

Anatomical Characters.—Rilliet and Barthez, who of foreign writers treat of cholera infantum at greatest length, describe it under the name of gastro-intestinal choleriform catarrh. "The perusal," they remark, "of anatomico-pathological descriptions, and especially the study of the facts, show that the gastro-intestinal tube in subjects who succumb to this disease may be in four different states: (*a*) either the stomach is softened without any lesion of the digestive tube; (*b*) or the stomach is softened at the same time that the mucous membrane of the intestine, and especially its follicular apparatus, is diseased; (*c*) or the stomach is healthy, while the follicular apparatus or the mucous membrane is diseased; (*d*) or, finally, the gastro-intestinal tube is not the seat of any lesion appreciable to our senses in the present state of our knowledge, or it presents lesions so insignificant that they are not sufficient to explain the gravity of the symptoms.

"So far, the disease resembles all the catarrhs, but what is special is the abundance of serous secretion and the disturbance of the great sympathetic nerve.

"The serous secretion, which appears to be produced by a perspiration (analogous to that of the respiratory passages and of the skin) rather than by a follicular secretion, shows, perhaps, that the elimination of substances is effected by other organs than the follicles; perhaps, also, we ought to see a proof that the materials to eliminate are not the same as in simple catarrh. Upon all these points we are constrained to remain in doubt. We content ourselves with pointing out the fact."[1]

On the 1st of August, 1861, I made the autopsy of an infant sixteen months old who died of cholera infantum with a sickness of less than one day. The examination was made thirty hours after death. Nothing unusual was observed in the brain, unless perhaps a little more than the ordinary injection of vessels at the vertex. No marked anatomical change was observed in the stomach and intestines, except enlargement of the patches of Peyer as well as of the solitary and mesenteric glands. Mucous membrane pale. In this and the following cases there was apparently slight softening of the intestinal mucous membrane, but whether it was pathological or cadaveric was uncertain, as the weather

[1] Maladies des Enfants.

was very warm. The liver seemed healthy. Examined by the microscope, it was found to contain about the normal number of oil-globules.

The second case was that of an infant seven months old, wet-nursed, who died July 26, 1862, after a sickness also of about one day. He was previously emaciated, but without any marked ailment. The post-mortem examination was made on the 28th. The brain was somewhat softer than natural, but otherwise healthy. There was no abnormal vascularity of the membranes of the brain, and no serous effusion within the cranium. The mucous membrane of the intestines had nearly the normal color throughout, but it seemed somewhat thickened and softened; the solitary glands of the colon were prominent. The patches of Peyer were not distinct.

In the New York Protestant Episcopal Orphan Asylum an infant twenty months old, previously healthy, was seized with cholera infantum on the 25th of June, 1864. The alvine evacuations, as is usual with this disease, were frequent and watery, and attended by obstinate vomiting. Death occurred in slight spasms in thirty-six hours. The exciting cause was probably the use of a few currants which were eaten in a cake the day before, some of which fruit was contained in the first evacuations. The brain was not examined. The only pathological changes which were observed in the stomach and intestines were slightly vascular patches in the small intestines and an unusual prominence of the solitary glands in the colon. The glands resembled small beads imbedded in the mucous membrane. The lungs in the above cases were healthy, excepting hypostatic congestion.

Since the date of these autopsies I have made others in cases which terminated fatally after a brief duration, and have uniformly found similar lesions—to wit, the gastro-intestinal surface either without vascularity or scantily vascular in streaks or patches, sometimes presenting a whitish or soggy appearance and somewhat softened, while the solitary glands were enlarged so as to be prominent upon the surface. In cases which continue longer evident inflammatory lesions soon appear which are identical with those which have already been described in our remarks relating to the ordinary form of diarrhœa.

During my term of service in the New York Foundling Asylum in the summer of 1884, an infant died after a brief illness with all the symptoms of cholera infantum, and the intestines were sent to William H. Welch, now of Johns Hopkins Hospital, for microscopic examination. His report was as follows: "I found undoubted evidence of acute inflammation. There was an increased number of small, round cells (leucocytes) in the mucous and submucous coats. This accumulation of new cells was most abundant in and around the solitary follicles, which were greatly swollen. Clumps of lymphoid cells were found extending even a little into the muscular coat. The epithelial lining of the intestine was not demonstrable, but this is usually the case with post-mortem specimens of human intestine, and justifies no inferences as to pathological changes. The glands of Lieberkühn were rich in the so-called goblet-cells, and some of the glands were distended with mucus and desquamated epithelium, so as to present sometimes the appearance of little cysts. This was observed especially in the neighborhood of the

solitary follicles. The bloodvessels, especially the veins of the submucous coat, were abnormally distended with blood. I searched for microörganisms, and found them in abundance upon the free surface of the intestine, in the mucous accumulations there, and also in the mouths of the glands of Lieberkühn. Both rod-shaped and small round bacteria were found. I attach no especial importance to finding bacteria upon the surface of the intestine. The general result of the examination is to confirm the view that cholera infantum is characterized by an acute intestinal inflammation."

NATURE.—Cholera infantum appears from its symptoms and lesions to be the most severe form of intestinal catarrh to which infants are liable. The alvine discharges, to which the rapid prostration is largely due, probably consist in part of intestinal secretions and in part of serum which has transuded from the capillaries of the intestines. That the intestinal mucous membrane sometimes presents a pale appearance at the autopsy of an infant who, previously well, has died of cholera infantum after a sickness of twenty-four or forty-eight hours, is perhaps due to the great amount of liquid secretion and transudation in which the inflamed surface is bathed. Moreover, it is, I believe, a recognized fact that the hyperæmia of an acutely inflamed surface when of short duration frequently disappears in the cadaver, as that of scarlet fever and erysipelas. The early hyperplasia of the solitary and mesenteric glands, and the hyperæmia and thickening of the surface of the ileum and colon in those who have survived a few day, indicate the inflammatory character of the malady.

The opinion has been expressed by certain observers that cholera infantum is identical with thermic fever or sunstroke. There is indeed a resemblance to thermic fever as regards certain important symptoms. In cholera infantum the temperature is from 105° to 108°; in sunstroke it is also very high, often running above 108°. Great heat of head, contracted pupils, thin fecal evacuations, embarrassed respiration, scanty urine, and cerebral symptoms are common toward the close of cholera infantum, and they are the prominent symptoms in sunstroke. Nevertheless, I cannot accept the theory which regards these maladies as identical, and which removes cholera infantum from the list of intestinal diseases. In cholera infantum the gastro-intestinal symptoms always take the precedence, and are, except in advanced cases, always more prominent than other symptoms. It does not commence as by a stroke like *coup de soleil*, but it comes on more gradually, though rapidly, and it often supervenes upon a diarrhœa or some error of diet. In the commencement of cholera infantum the infant is usually not drowsy, and is often wide awake and restless from the thirst. Contrast this with the alarming stupor of sunstroke. Sunstroke only occurs during the hours of excessive heat, but cholera infantum may occur at any hour or in any day during the hot weather, provided that there be sufficient dietetic cause. Again, intestinal inflammation is not common in sunstroke, while it is the common, or, as I believe, the essential lesion of cholera infantum. These facts show, in my opinion, that the two maladies are essentially and entirely distinct. Nevertheless, cases of apparent sunstroke sometimes occur in the infant, and if the bowels

are at the same time relaxed the disease may be regarded as cholera infantum, and if fatal is usually reported as such to the health authorities. Cases of this kind I have occasionally observed or they have been reported to me, although they are not common.

With the exception of the organs of digestion no uniform lesions are observed in any of the viscera in cholera infantum, except such as are due to change in the quantity and fluidity of the blood and its circulation. Writers describe an anæmic appearance of the thoracic and abdominal viscera, and occasionally passive congestion of the cerebral vessels. The cerebral symptoms usually present toward the close of life in unfavorable cases of cholera infantum are often due to spurious hydrocephalus, which we have described above; but as the urinary secretion is scanty or suppressed, cerebral symptoms may, in certain cases, be due to uræmia.

Diagnosis.—This form of the summer diarrhœa is diagnosticated by the symptoms, and especially by the frequency and character of the stools. The stools have already been described as frequent, often passed with considerable force, deficient in fecal matter, and thin, so as to soak into the diaper almost like urine. The vomiting, thirst, rapid sinking, and emaciation serve to distinguish cholera infantum from other diarrhœal maladies.

When Asiatic cholera is prevalent the differential diagnosis between the two is difficult if not impossible.

Prognosis.—Cholera infantum is one of those diseases in regard to which physicians often injure their reputation by not giving sufficient notice of the danger, or even by expressing a favorable opinion when the case soon after ends fatally. A favorable prognosis should seldom be expressed without qualification. If the urgent symptoms be relieved, still the disease may continue as an ordinary intestinal inflammation, which in hot weather is formidable and often fatal. If the stools become more consistent and less frequent without the occurrence of cerebral symptoms, while the limbs are warm and the pulse good, we may confidently express the opinion that there is no present danger.

The duration of true cholera infantum is short. It either ends fatally, or it begins soon to abate and ceases, or it continues, and is not to be distinguished in its subsequent course from an attack of summer diarrhœa beginning in the ordinary manner.

Treatment of Infantile Diarrhœa.—Obviously, efficient preventive measures consist in the removal of infants so far as practicable from the operation of the causes which produce the disease. Weaning just before or in the hot weather should, if possible, be avoided, and removal to the country should be recommended, especially for those who are deprived of breast-milk during the age when such nutriment is required. If for any reason it is necessary to employ artificial feeding for infants under the age of ten months, that food should obviously be used which most closely resembles human milk in digestibility and in nutritive properties. Care should be taken to prevent fermentation in the food before its use, since much harm is done by the employment of milk or other food in which fermentative changes have occurred and which occur quickly in dietetic mixtures in the hot months.

It is also very important that the infant receive its food in proper quantity and at proper intervals, for if the mother or nurse in her anxiety to have it thrive feed it too often or in too large quantity, the surplus food which it cannot digest if not vomited undergoes fermentation, and consequently becomes irritating to the gastro-intestinal surface. The physician should be able to give advice not only in reference to the frequency of feeding, but also in regard to the quantity of food which the infant requires at each feeding. Correct knowledge and advice in this matter aid in the prevention and cure of the diarrhœal maladies of infancy. The reader is referred to the chapters relating to the feeding of infants. Avoidance of exposure to cold or to sudden changes of temperature are important preventive measures, since cases of intestinal catarrh of infants occur from this cause, though less frequently than from errors in diet.

Curative Treatment.—The indications for treatment are: 1st. To provide the best possible food, which will afford sufficient nutriment, and be easily digested. 2d. To aid the digestive functions of the infant. 3d. To employ such medicinal agents as can be safely given to check the diarrhœa and cure the intestinal catarrh. 4th. To procure fresh air, which is especially needed if the diarrhœa be that of the summer season.

The infant with this disease is thirsty, and is therefore likely to take more nutriment in the liquid form than it requires for its sustenance. If nursing, it craves the breast, or if weaned, craves the bottle, at short intervals, to relieve the thirst. No more nutriment should be allowed than is required for nutrition, for the reason stated above, and the thirst may best be relieved by a little cold water, gum-water, or barley-water, to which a few drops of brandy or whiskey are added. Infantile diarrhœa of the summer season, so common and fatal in the cities, requires in some respects different treatment from that which is appropriate for diarrhœa occurring at other seasons, and due to other causes than those incident to hot weather.

Since one of the two important factors in producing the summer diarrhœa is the use of improper food, it is obviously very important for the successful treatment of this disease that the food should be of the right kind, properly prepared, and given in proper quantity. I need not repeat that for infants under the age of one year no food is so suitable as breast-milk, and one affected with the diarrhœa and remaining in the city should, if possible, at least if under the age of ten months, be provided with breast-milk. It can be more satisfactorily treated and the chances of its recovery are much greater if it be nourished with human milk than by any other kind of diet. If, however, the mother's milk fail or become unsuitable from ill-health or pregnancy, and on account of family circumstances a wet-nurse cannot be procured, the important and difficult duty devolves upon the physician of deciding how the infant should be fed. The reader is referred to Chapter VIII. Part I., for facts relating to the feeding of infants.

But since one of the two important factors in producing the summer diarrhœa of infants is foul air, it is obvious that measures should be employed to render the atmosphere in which the infant lives as free as

possible from noxious effluvia. Cleanliness of the person, of the bedding, and of the house in which the patient resides, the prompt removal of all refuse animal or vegetable matter, whether within or around the premises, and allowing the infant to remain a considerable part of the day in shaded localities where the air is pure, as in the parks or suburbs of the city, are important measures. In New York great benefit has resulted from the floating hospital which every second day during the heated term carries a thousand sick children from the stifling air of the tenement houses down the bay and out to the fresh air of the ocean.

But it is difficult to obtain an atmosphere that is entirely pure in a large city with its many sources of insalubrity; and all physicians of experience agree in the propriety of sending infants affected with the summer diarrhœa to localities in the country which are free from malaria and sparsely inhabited, in order that they may obtain the benefits of purer air. Many are the instances each summer in New York City of infants removed to the country with intestinal inflammation, with features haggard and shrunken, with limbs shrivelled and the skin lying in folds, too weak to raise, or at least hold, their heads from the pillow, vomiting nearly all the nutriment taken, with stools frequent and thin, resulting in great part from molecular disintegration of the tissues—presenting, indeed, an appearance seldom observed in any other disease except in the last stages of phthisis—and returning in late autumn with the cheerfulness, vigor, and rotundity of health. The localities usually preferred by the physicans of this city are the elevated portions of New Jersey and Northern Pennsylvania, the Highlands of the Hudson, the central and northern parts of New York State, and Northern New England. Taken to a salubrious locality and properly fed, the infant soon begins to improve if the disease be still recent, unless it be exceptionally severe. If the disease have continued several weeks at the time of the removal, little benefit may be observed from the country residence until two or more weeks have elapsed.

An infant weakened and wasted by the summer diarrhœa, removed to a cool locality in the country, should be warmly dressed and kept indoor when the heavy night dew is falling. Patients sometimes become worse from injudicious exposure of this kind, the intestinal catarrh from which they are suffering being aggravated by taking cold, and perhaps rendered dysenteric.

Sometimes parents, not noticing the immediate improvement which they have been led to expect, return to the city without giving the country fair trial, and the life of the infant is then, as a rule, sacrificed. Returned to the foul air of the city while the weather is still warm, it sinks rapidly from an aggravation of the malady. Occasionally, the change from one rural locality to another, like the change from one wet-nurse to another, has a salutary effect. The infant, although it has recovered, should not be brought back while the weather is still warm. One attack of the disease does not diminish, but increases, the liability to a second seizure.

Medicinal Treatment. The diarrhœa of infancy requires, to some extent, different treatment in its early and later stages. We have seen that acids, especially the lactic and butyric, the results of faulty

digestion, are often produced, causing acid stools. In a few days the inflammatory irritation of the mucous follicles causes such an exaggerated secretion of alkaline mucus that the acid is nearly or quite neutralized. In the commencement of the attack these acid and irritating products should be as quickly as possible neutralized, while we endeavor to prevent their production by improving the diet and assisting the digestion. In the second stage, when the fecal matter is less acid and irritating from the large admixture of mucus, medicines are required to improve digestion and check the diarrhœa, while the indication for antacids is less urgent. Therefore it is convenient to consider separately the treatment which is proper in the commencement or first stage, and that which is required in the subsequent course of the disease.

First stage, or during the first three or four days, perhaps the first week. Occasionally, it is proper to commence the treatment by the employment of some gentle purgative, especially when the disease begins abruptly after the use of indigestible and irritating food. A single dose of castor oil or syrup of rhubarb, or the two mixed, will remove the irritating substance, and afterward opiates or the remedies designed to control the disease can be more successfully employed. Ordinarily, such preliminary treatment is not required. Diarrhœa has generally continued several days when the physician is summoned, and no irritating substance remains save the acid which is so abundantly generated in the intestines in this disease, and which we have the means of removing without purgation.

The same general plan of medicinal treatment is appropriate for the summer diarrhœa of infants as for diarrhœa from other causes; but the acid fermentation present in greater degree in the former than in the latter, indicates the greater need of antacids, which should be employed in most of the mixtures used in the first stage as long as the stools have a decidedly acid reaction.

Those who accept the theory that infantile diarrhœa of the summer season is produced by microörganisms which lodge on the gastro-intestinal surface and produce diarrhœa by their irritating effect, are naturally led to employ antiseptic remedies. Guaita administered for this purpose sodium benzoate. One drachm or a drachm and a half dissolved in three ounces of water were administered in twenty-four hours with, it is stated, good results.[1] I have no experience in the use of antiseptic remedies in any form of infantile diarrhœa.

If by the appearance of the stools or the substance ejected from the stomach, or by the usual test of litmus-paper, the presence of an acid in an irritating quantity be ascertained or suspected, lime-water or sodium bicarbonate may be added to the food. The creta præparata of the Pharmacopœia administered every two hours, or, which is more convenient, the mistura cretæ, is a useful antacid for such a case. The chalk should be finely triturated. By alkalies alone, aided by the judicious use of stimulants, the disease is sometimes arrested, but, unless circumstances are favorable and the case be mild, other remedies are required.

[1] New York Medical Record, May 31, 1884.

Opium has long been used, and it retains its place as one of the important remedies in infantile diarrhœa. For the treatment of a young infant paregoric is a convenient opiate preparation. For the age of one or two months the dose is from three to five drops; for the age of six months, twelve drops, repeated every three hours or at longer intervals according to the state of the patient. After the age of six months the stronger preparations of opium are more commonly used. The tinctura opii deodorata or Squibb's liquor opii compositus may be given in doses of one drop at the age of one year. Dover's powder in doses of three-fourths of a grain, or the pulvis cretæ comp. cum opio in three-grain doses every third hour, may be given to an infant of one year.

Opium is, however, in general best given in mixtures which will be mentioned hereafter. It quiets the action of the intestines and diminishes the number of the evacuations. It is contraindicated or should be used with caution if cerebral symptoms are present. Sometimes in the commencement of the disease, when it begins abruptly from some error in diet, with high temperature, drowsiness, twitching of the limbs—symptoms which threaten eclampsia—opiates should be given cautiously before free evacuations occur from the bowels and the offending substance is expelled. Under such circumstances a few doses of the bromide of potassium are preferable. In the advanced stage of the disease also, when symptoms of spurious hydrocephalus occur, opium should be withheld or cautiously administered, since it may tend to increase the fatal stupor in which severe cases are liable to terminate; but, except in such cases, opium is a most useful remedy.

The vegetable astringents, although they have been largely employed in the treatment of the various forms of infantile diarrhœa, are much less frequently prescribed than formerly. As a substitute for them the subnitrate of bismuth has come into use, and in much larger doses than were formerly employed. While it aids in checking the diarrhœa, it is an efficient antiemetic and antiseptic. It should be prescribed in ten or twelve grains for an infant of twelve months; larger doses produce no ill effect, for its action is almost entirely local and soothing to the inflamed surface with which it comes in contact. It undergoes a chemical change in the stomach and intestines, becoming black, being converted into the bismuth sulphide, and it causes dark stools. Rarely it produces in the infant the well-known garlicky odor, like that occasionally observed in adult patients, and which is supposed to be due to tellurium accidentally associated with the bismuth in its natural state. For those cases in which the symptoms are chiefly due to colitis, and the stools contain blood with a large proportion of mucus, it has been customary to prescribe laudanum or some other form of opium with castor oil. I prefer, however, the bismuth and opium for such cases as are more decidedly dysenteric, as well as for cases of the usual form of intestinal catarrh.

The following are convenient and useful formulæ for a child of one year:

℞.—Tinct. opii deodorat. . . . . ℳ xvj.
Bismuth. subnitrat. . . . . ʒ ij.
Syrupi . . . . . ℥ ij
Misturæ cretæ . . . . . f ʒ xiv.—Misce.
Shake thoroughly and give one teaspoonful every two to four hours.

℞.—Tinct. opii deodorat. . . . . ♏xvj.
Bismuth. subnitrat. . . . . ʒij.
Syrupi . . . . . fʒss
Aq. cinnamomi . . . . . fʒiss.—Misce.
Shake bottle; give one teaspoonful every two to four hours.

℞.—Bismuth. subnitrat. . . . . ʒij
Pulv. cret. comp. c. opio . . . . . ʒss.—Misce.
Divid in chart No. x. Dose, one powder every three hours.

℞.—Bismuth. subnitrat. . . . . ʒij.
Pulv. ipecac. comp. . . . . gr. ix.—Misce.
Divid in chart No. xii. Dose, one powder every three hours.

Cholera infantum requires similar treatment to that which is proper for the ordinary form of infantile diarrhœa, but there is no disease, unless it is pseudo-membranous croup, in which early and appropriate treatment is more urgently required, since the tendency is to rapid sinking and death. As early as possible, therefore, proper instructions should be given in regard to the feeding, and for an infant between the ages of eight and twelve months either one of the above prescriptions should be given or the following:

℞.—Tinct. opii deodorat. . . . . ♏xvj.
Spts. ammon. aromat. . . . . fʒj.
Bismuth. subnitrat. . . . . ʒij.
Mucil. acaciæ vel syrupi . . . . . fʒss.
Misturæ cretæ . . . . . fʒiss—Misce.
Shake bottle. Give one teaspoonful every two or three hours.

An infant of six months can take one-half the dose, and one of three or four months one-third or one-fourth the dose, of either of the above mixtures.

If cerebral symptoms appear, as rolling the head, drowsiness, etc., I usually write the prescription without the opiate; and with this omission it may be given more frequently if the case require it, while the opiate prescribed alone or with bromide of potassium is given guardedly and at longer intervals. Injury to the patient from the use of the opiate can only occur through carelessness in not giving proper attention to his condition. It is chiefly in advanced cases, when the vital powers are beginning to fail, when the innervation is deficient, and cerebral circulation sluggish, that the use of opiates may involve danger. Explicit and positive directions should be given to omit the opiate or to give it less frequently whenever the evacuations are checked wholly or partially and signs of stupor appear.

Second Stage. Infantile diarrhœa in a large proportion of cases begins in such a gradual way that the treatment which we are about to recommend is proper in many instances at the first visit of the physician, who is frequently not summoned until the attack has continued one or two weeks. The alkaline treatment recommended above for the diarrhœa in its commencement does not aid digestion sufficiently to justify its continuance as the main remedy after the first few days. In a large number of instances, however, one of the above alkaline mixtures may be given with advantage midway between the nursings or

feedings, while those remedies, presently to be mentioned, which facilitate digestion and assimilation are given at the time of the reception of food.

Some physicians of large experience, as Henoch, of Berlin, recommend small doses of calomel, as the twelfth or twentieth of a grain, three or four times daily for infants with faulty digestion and diarrhœa. To me, this seems an uncertain remedy, without sufficient indications for its use, and I have therefore no experience with it. The following are formulæ which I employ in my own practice, which have been employed with apparent good results in the institutions in New York in those frequent cases in which diarrhœa is associated with indigestion:

℞.—Acid. muriat. dilut. . . . . ♏xvj.
Pepsinæ saccharat. (Hawley's or other good pepsin) ʒj.
Bismuth. subnitrat. . . . . ʒij.
Syrupi . . . . . fʒij.
Aquæ . . . . . fʒxiv.—Misce.
Shake bottle; give one teaspoonful before each feeding or nursing to an infant of one year; half a teaspoonful to one of six months.

℞.—Tinct. opii deodorat. . . . . ♏xvj.
Pepsinæ saccharat. . . . . ʒj.
Bismuth. subnitrat. . . . . ʒij.
Syrupi . . . . . fʒij.
Aquæ . . . . . fʒxiv.—Misce.
Shake bottle: give one teaspoonful every three hours to a child of one year; half a teaspoonful to one of six months.

℞.—Pepsinæ saccharat. . . . . ʒj–ij.
Bismuth. subnitrat. . . . . ʒij.—Misce.
Divid in chart No. xii. One powder every three hours to a child of one year.

In occasional cases in which the stomach is very irritable, so that medicines given by the mouth are in great part rejected, our reliance must be largely on rectal medication, and especially on clysters containing an opiate. Laudanum may be given in this manner with marked benefit. It may be given mixed with a little starch-water, and the best instrument for administering it is a small glass or gutta-percha syringe, the nurse retaining the enema for a time by means of a compress. Beck, in his *Infant Therapeutics*, advises to give by the clyster twice as much of the opiate as would be required by the mouth. A somewhat larger proportion may, however, be safely employed. The following formula for a clyster has given me more satisfaction than any other medicated enema which I have employed:

℞.—Argent. nitrat. . . . . gr. iv.
Bismuth. subnitrat. . . . . ʒss.
Mucilag. acaciæ } . . . . . āā fʒij.—Misce.
Aquæ }

One-quarter to one-half of this should be given at a time, with the addition of as much laudanum as is thought proper; and it should be retained by the compress. It is especially useful when from the large amount of mucus or mucus tinged with blood it is probable that the descending colon is chiefly involved.

Alcoholic stimulants are required almost from the commencement of the disease, and they should be employed in all protracted cases. Whiskey or brandy is the best of these stimulants, and it should be given in small doses at intervals of two hours. I usually order three or four drops for an infant of one month, and an additional drop or two drops for each additional month. The stimulant is not only useful in sustaining the vital powers, but it also aids in relieving the irritability of the stomach and in preventing hypostasis in depending portions of the lung and brain, which, as we have seen, is so frequent in advanced cases.

The vomiting which is so common a symptom in many cases greatly increases the prostration, and should be immediately relieved if possible. The following formulæ will be found useful for it:

℞.—Bismuth. subnitrat. . . . . ʒij.
Spts. ammon. aromat. . . . . fʒss–ʒj.
Syrupi } . . . . . āā fʒj.—Misce.
Aquæ }

Shake bottle. Dose, one teaspoonful half-hourly or hourly if required, made cold by a piece of ice.

℞.—Acid. carbolic. . . . . gtt. ij.
Liquor. calcis . . . . . fʒij.—Misce.

Dose, one teaspoonful, with a teaspoonful of milk (breast-milk if the baby nurse), to be repeated according to the nausea.

Lime-water with an equal quantity of milk often relieves the nausea when it is due to acids in the stomach, but it is rendered more effectual in certain cases by the addition of carbolic acid, which tends to check any fermentative process. A minute dose of tincture of ipecacuanha, as one-eighth of a drop in a teaspoonful of ice-water, frequently repeated, has also been employed with alleged benefit.

Of these various antiemetics, my preference is for the bismuth in large doses, with the aromatic spirits of ammonia, properly diluted, that the ammonia do not irritate the stomach. Nevertheless, in certain patients the nausea is very obstinate, and all these remedies fail. In such cases absolute quiet of the infant on its back, the administration of but little nutriment at a time, mustard over the epigastrium, and the use of an occasional small piece of ice or the use of carbonic acid water with ice in it, may relieve this symptom.

In protracted cases, when the vital powers begin to fail, as indicated by pallor, more or less emaciation, and loss of strength, the following is the best tonic mixture with which I am acquainted. It aids in restraining the diarrhœa, while it increases the appetite and strength. It should not be prescribed until the inflammation has assumed a subacute or chronic character:

℞.—Tinct. columbæ . . . . . fʒiij.
Liq. ferri nitratis . . . . . ♏xxvij.
Syrupi . . . . . fʒiij.—Misce.

Dose, one teaspoonful every three or four hours to an infant of one year.

External Treatment.—Some writers recommend depletion by leeching in intestinal inflammation, when the infant is robust and of full habit, and the disease commences suddenly with decided febrile

reaction. Such cases are oftenest seen with us in the winter season, and even these are ordinarily best treated without loss of blood. Sinapisms and poultices usually are sufficient as local measures. In these cases, also, the warm mustard foot-bath should be employed, and repeated if there be restlessness or cerebral symptoms.

In all forms of intestinal inflammation in infancy and in all its stages mild counter-irritation over the abdomen is often useful, but vesication, by increasing the restlessness of the infant and reducing its strength, without materially modifying the severity or duration of the disease, does more harm than good. It is not to be thought of as a remedial measure. I have known a troublesome sore continuing till death, and probably hastening this result, to occur from this treatment. Poultices or fomentations over the abdomen are sometimes beneficial, especially those of a mildly irritating nature. A poultice of powdered cloves, cinnamon, and ginger, or of linseed meal to which a little mustard is added, may be employed, or a linseed poultice spread thin, under which a single layer of muslin is placed, saturated with camphorated oil or tincture of camphor, and over both oil silk. In the entero-colitis of infants, occurring in the cool months, and due to exposure to cold, this treatment is especially useful. In the epidemic entero-colitis of the summer months, which may be aggravated by heat, treatment by poultices may be injudicious, but in such cases it is proper to produce moderate redness over the abdomen by temporary applications.

CHAPTER IX.

ENTERITIS AND COLITIS IN CHILDHOOD.

Intestinal inflammation in childhood differs materially from the form or type which it commonly presents in infancy. Its causes, symptoms, and extent vary in important particulars in the two periods. In childhood there is not ordinarily such extensive inflammation of the mucous membrane of the intestines as we have seen is present in the majority of cases in infancy, and it may, therefore, be properly treated as two diseases, according to the seat of the morbid process, namely, enteritis and colitis. Both these affections in the child resemble so closely the form which they exhibit in adult life, that no extended description is needed in this connection.

Causes.—A main cause is sudden reductions of temperature by exposure to cold, or to currents of air, which checks perspiration, and causes determination of blood from the surface to the viscera. These inflammations are also caused sometimes by irritating substances in the intestines. I have known fecal accumulations as well as worms to produce severe dysentery in the child, accompanied by the characteristic

tenesmus and muco-sanguineous stools, and ceasing as soon as the offending substances were expelled. The use of unripe or stale vegetables, if there be a strong predisposition to mucous inflammation, may be a sufficient cause, and some of the most dangerous cases are due to the accumulation in the intestines of seeds and the parenchyma of fruits. But the most common cause is that mentioned, namely, sudden exposure to cold when the body is heated, a danger to which children are especially liable, on account of the easy disturbance of the circulatory system in them, and their heedless exposure of themselves, unless incessantly watched. Enteritis and colitis are also frequently secondary diseases occurring in childhood as complications or sequelæ of the eruptive fevers, especially measles.

Symptoms.—The alvine discharges in enteritis and colitis in childhood are such as occur in these diseases at a more advanced age. In enteritis they are thin and of the natural color, or occasionally green; in colitis they are more consistent than in enteritis, and are largely muco-sanguineous. Sometimes in enteritis, if the inflammation be not intense, the diarrhœa is slow in appearing, or it may be slight, so as not to attract special attention. The disease may then resemble remittent fever, for which it is at times mistaken. The upper part of the small intestines is less frequently affected than the lower. If there be duodenitis, the flow of bile is occasionally impeded from tumefaction of the mouth of the common bile-duct, and the icteric hue appears. In both enteritis and colitis there is abdominal tenderness, with more or less constant pain if the disease be severe, and in colitis, tormina and tenesmus. The pulse is accelerated, the heat of surface augmented, the face flushed, and, except in mild cases, expressive of pain. In many children at the commencement of the inflammation the nervous system is profoundly affected, as indicated by headache, stupor, twitching of the limbs, and sometimes by convulsions. The chief danger at the commencement of the disease is, indeed, from this source. Sometimes irritability of the stomach occurs, and the food is rejected, though much less frequently than in the intestinal inflammation of infancy. Anorexia and thirst are common symptoms. If the inflammation continue, there is soon perceptible emaciation, with loss of strength. The eyes become hollow, the face pallid, and the surface cool. Death may occur at an early period, the vital powers succumbing from the intensity of the inflammation. In other cases, the acute disease ends in a subacute or chronic inflammation; the patient becomes gradually more reduced, till he dies in a state of extreme emaciation, such as we often observe in the entero-colitis of infancy; or from this state he may recover by degrees, though perhaps with an irritable state of the bowels, which continues for months. In a majority of cases, however, enteritis and colitis in childhood, if properly treated, soon begin to yield, and they terminate favorably in one or two weeks.

Diagnosis.—It is not difficult to determine the existence of the inflammation. This is indicated by the fever, abdominal tenderness, and the relaxed state of the bowels. Whether the disease be enteritis or colitis is determined by the character of the stools, the seat of the tenderness and the presence or absence of tenesmus.

PROGNOSIS.—It has been stated above that enteritis and colitis in children commonly terminate favorably. The result depends not only on the extent and severity of the inflammation, but the constitution and previous health. The inflammation is more serious when secondary than when primary. Extensive and great tenderness of the abdomen, features pallid, anxious, and expressive of suffering, pulse frequent and feeble, should excite the most serious apprehensions. Frequent vomiting also denotes a grave form of the disease. Stupor, and especially convulsive movements, show that the nervous centres are affected, and should make us guarded in the prognosis. Improvement in the disease, on which to base a favorable prediction, is apparent in the diminution of the tenderness, improvement in the pulse and character of the stools, a more cheerful countenance, and less disrelish of food.

TREATMENT.—This should be similar to that employed for the adult. In enteritis at the commencement of the disease, if there be reason to suspect the presence of any irritating substance in the intestines, and ordinarily in colitis, it is advisable to commence treatment by the use of some simple evacuant, like castor oil. After this our reliance, so far as internal treatment is concerned, must be mainly on opiate and antiphlogistic medicines. One of the best remedies of this class is the Dover's powder, which may be given to a child five years old in doses of three grains every three hours. A corresponding dose of any of the other opiates may be given, but with less sudorific effect. In colitis the occasional administration of a laxative should not be neglected, if the stools be entirely or mainly muco-sanguineous. It should be employed so as to prevent accumulation of fecal matters in the colon, which would serve as an irritant and increase the inflammation. The dose should be small, merely sufficient to produce fecal evacuation, and repeated as required, daily or less frequently. The laxatives commonly preferred are magnesia, rhubarb, or castor oil. The physician may prescribe an opiate mixture containing sufficient of the laxative to have the effect desired, though ordinarily it is better to prescribe the two separately, so that the laxative can be given or withheld, according to circumstances, while the opiate is continued more regularly. Except that there be some irritating substance which requires removal, the effect of laxatives is injurious, instead of beneficial. Most of the formulæ given above in our remarks relating to the treatment of infantile intestinal catarrh are likewise useful for the enteritis and colitis of childhood, the quantity of the opiate, which is the important ingredient, being increased according to the increase in the age. The following prescriptions may be employed for a child of five years:

℞.—Pulv. opii . . . . . gr. v.
Bismuth. subnitrat. . . . . ʒij.—Misce.
Divid in pulveres No. xx. Give one powder every two to four hours.

℞.—Pulv. ipecac. comp. . . . . ʒj.
Bismuth. subnitrat. . . . . ʒij.—Misce.
Divid in pulveres No. xxiv. Give one powder as above.

℞.—Tinc. opii deodorat. . . . . ʒss.
Bismuth. subnitrat. . . . . ʒij.
Aq. menth. piperit.,
Syr. zingiberis . . . . . āā ʒj.—Misce.
Shake bottle. Give one teaspoonful from two to four hours.

The local treatment which is found most useful consists in the use of emollient applications covered with oil-silk, and made sufficiently irritating by mustard or otherwise to cause constant redness.

The diet should be bland and unirritating. In the first stages of the inflammation, rice or barley-water, or arrowroot boiled in water, and similar drinks should constitute the main diet. When the active inflammation has abated, and at any period of the disease if there be a tendency to prostration, more nourishing food should be given. Milk and animal broths may then be allowed. In cases which are protracted, or attended with symptoms of exhaustion, alcoholic stimulants are required.

CHAPTER X.

CONSTIPATION

The gastro-intestinal portion of the digestive apparatus has a double function. First, it receives and retains the food during the process of digestion; it furnishes the most important of the liquids by which digestion is effected, and it absorbs those products of digestion which are required for the nutrition of the body, while it serves as a barrier against the admission of refuse matter. Secondly, it has an excretory function, so that a large part of the waste and noxious products of the system are eliminated from its surface. Having, therefore, a relation so close and fundamental to the general nutrition, it is necessary, for the normal activity of the organs and the maintenance of health, that its functions be regularly and fully performed. But retention of fecal matter beyond the normal period is one of the most common ailments both in infancy and childhood, and occasionally it constitutes a grave disease.

Constipation is of two kinds, namely, *symptomatic* and *idiopathic*.

Symptomatic Constipation. Causes.—Many of these are obstructive. The more common of them are the following: (*a*) Congenital stenosis, or occlusion of the anus or rectum. The anus is not formed, or it terminates in a cul-de-sac, while the lower end of the large intestines forms another cul-de-sac. These two cul-de-sacs, lying opposite each other, one looking upward and the other downward, may be separated from each other by a small interspace, a fibrous septum, so that relief can be obtained by a puncture or incision, or they may be widely separated, so that there is no possible mode of relief, and death is inevitable, unless the fecal matter escape through a congenital fistulous passage upon one of the adjacent mucous surfaces, which mode of relief was present in forty per cent. of the cases of this obstruction collected by Leichtenstern. Exceptionally this malformation occurs in the sigmoid flexure, while the rectum is normal. The stenosis, if slight, may

produce little delay in the evacuations, except when hardened masses or coase, indigestible substances descend upon it, and it may, therefore, with careful selection of diet, cause little inconvenience for a lengthened period, while much stenosis causes early obstructive symptoms.

Rarely the stenosis is at the ileo-cæcal orifice. Thus, in the *Transactions of the Lond. Path. Soc.*, for 1870, is the history of a case in which there was such narrowing of the ileo-cæcal orifice, believed to be congenital, that a No. 9 catheter could barely be passed through it. The patient lived till his thirty-second year, having suffered from an early age with frequent attacks of colic and constipation. After his death, the ileum next to the ileo-cæcal valve was found to have a diameter of seven inches, while the large intestine was much atrophied, and its entire lumen contracted from the long disuse. Occasionally, the narrowing occurs a little above the ileo-cæcal orifice, and more rarely in the duodenum, at the point of union of the pancreatic or bile-duct with the intestine. In the last situation, the obstacle sometimes appears to be hypertrophied valvulæ conniventes, the edges of two opposite folds becoming more or less adherent. Such congenital intestinal obstructions, whether, as is probable, produced by inflammations in the fœtus or from simple perverted nutrition; whether arising from syphilitic cachexia or other cause, of course retard the evacuations, according to their locations and the degree of closure. The same degree of stenosis in the colon or rectum obviously causes more constipating effect than in the small intestine, since the excrementitious substance is firmer in the former than in the latter, and the latter have more mobility by which to overcome obstacles.

(*b*) *Intestinal Displacements.*—These produce obstructions of a very painful and dangerous kind. Intussusception and external hernia are too well known to require description. Both are likely to produce complete obstruction if not soon relieved, but there are cases of intussusception in children in which the displaced intestine remains pervious, and the evacuations occur with more or less regularity; and the same is true of one form of hernia, namely, the congenital, which, although painful, seldom produces serious obstruction.

Painful and dangerous occlusion and consequent arrest of alvine evacuations occasionally result from the imprisonment of a loop of intestine in an opening, usually congenital, in the mesentery or diaphragm, or from the knotting of one portion of intestine with another, as described by Leichtenstern, or again from the twisting of the intestine. Epstein and Soyka[1] relate the case of a newborn infant that died in the second week after birth with symptoms of obstruction. At the autopsy, a portion of the small intestine with its mesentery was found twisted upon its axis, from right to left, without any marked evidence of inflammation.

(*c*) Substances which have been swallowed, or substances whose nuclei have been swallowed, and which consist of a deposit of carbonate and phosphate of lime, or substances which have been produced entirely in the system, and which, lodged in narrow parts of the intestine, cause

[1] Centralb. f. d. med. Wissensch., April 24, 1879.

obstruction. Such substances, some of which occur most frequently in children, and others in elderly people, produce acute constipation. Indigestible matter contained in the food, as seeds or the parenchymatous portions of fruits, occasionally collects in considerable quantity and obstructs the intestine. A large gall-stone, having escaped from the common bile-duct, sometimes lodges in the intestine, either at the ileo-cæcal valve or, more rarely, at some other point, and retards the passage of fecal matter. But this seldom occurs in children.

In one instance, and in only one, have I known obstinate constipation to be produced by worms. The patient was a girl of about four years, in whom constipation came on suddenly, and was accompanied by distention of abdomen and great suffering. This continued nearly one week, when a mass of intertwined round worms was expelled, with immediate relief. The records of medicine also contain cases in which neoplasms, growing from the coats of the intestines internally, have attained such a size as to retard the evacuations.

(*d*) Abscesses and tumors, especially when occurring in the pelvis, also sometimes cause constipation by pressing upon the intestine, and obstructing or narrowing the passage through it. Thus, in 1868, Mr. Thomas Smith related to the London Pathological Society the case of an infant, aged fourteen months, in whom both alvine and urinary evacuations were retarded by a cancerous tumor growing between the rectum and bladder, and ending fatally in three months after the occurrence of the first symptoms.

(*e*) Peritonitis, during its continuance, is known to constipate the bowels. It is supposed that inflammatory œdema occurs around the muscular fibres of the middle coat, by which their contractility is impaired. Hence the lax state, the meteorism, and inaction of the intestines in this disease. When the peritonitis abates, the normal action is restored, and the evacuations occur regularly, if the free surface of the peritoneum have undergone no unfavorable change. But unfortunately peritonitis often produces more lasting injury, so as to interfere seriously with the intestinal movements, and produce an habitually torpid state of the bowels. This occurs from adventitious bands of inflammatory origin, which lie across the intestines, compressing them at the points of contact, and restrainiug their movements, and from adhesion of the intestinal loops.

The most marked cases which I have observed of this were children who had had tubercular peritonitis. The following was an interesting example:

Case.—Charles, aged 4 years, was returned to the New York Foundling Asylum on April 16, 1877, to be treated for tumor albus of the left knee, and for general ill-health. His parentage and early history were unknown. The nurse in the city, to whom he had been entrusted when quite small, stated that he had no sickness when with her, except sore eyes, and that about April 1, 1877, the enlargement of the knee was first observed. The head of the boy was large, and the abdomen much distended, but without any decided tenderness on pressure; its entire lower part had a purplish color. Percussion over it gave a dull sound, except upon and near the epigastrium, where there was some resonance; umbili-

cus prominent; circumference of body over abdomen, 23 inches; pulse 128; axillary temperature 99°. It was stated that he had no stool without medicine, and that, usually, one tablespoonful of castor oil was required to produce it. The urine contained no albumen, and was apparently normal. As the appearance indicated struma, a mixture of cod-liver oil, syrup of the lacto-phosphate of lime, and iron was prescribed, to be given three times daily, and directions were given to rub cod-liver oil over the abdomen also three times each day, for five minutes each time. Some nodules were felt, on pressure upon the abdomen, which we suspected were enlarged mesenteric glands. From the day on which the friction and kneading of the abdomen were commenced, the stools began to occur, on the average, about twice daily. The kneading proved the safest, as well as most efficient, method of producing defecation.

On May 4th, the circumference of the trunk over the most prominent part of the abdomen was reduced to twenty-two inches. The records on May 11th state: "Same treatment is continued; has tolerable appetite, but is pallid, and his flesh flabby and soft." On May 22d, the circumference of the trunk gave 22¾ inches. The tumor albus remained about the same.

I saw the patient again during attendance in the asylum, in August and November. The record in November states that he is feeble and failing; is becoming weaker and thinner; breath and exhalations from the surface offensive; he is kept quiet on account of the knee. From this time he gradually failed, and died April 11, 1878. There was no cough to attract attention; and instead of constipation, a diarrhœa of some weeks' continuance preceded death.

Autopsy.—Lungs healthy, except a little exudation over the summit of right lung; bronchial glands cheesy; numerous tubercles, some of them cheesy, upon the parietal and visceral surface of the peritoneum. Loops of the intestines were united to each other by old adhesions, and the small intestines were generally bound down by bands into a "uniform conglomeration;" mesenteric glands enlarged and cheesy; a large ulcer upon the surface of the rectum, and numerous small, round ulcers upon the surface of small and large intestines, apparently occupying the site of the solitary follicles.

Occasionally, a false band, the result of peritonitis, lies across the intestines, without restraining their movements, and producing no marked symptoms, and probably no symptoms at all, until a loop happens to pass underneath it, when, if not soon released, it is liable to become strangulated, with complete obstruction to the passage of fecal matter. This displacement might properly be classified with the internal hernias described above. In my own person, at the age of twelve years, such an accident occurred about two months after the peritonitis. Upon the abatement of the inflammation, a sensation of traction had been noticed in the umbilical region, almost daily, during exercise, and the displacement was indicated by the extreme pain which characterizes such cases, and which ceased suddenly, when the parts were released after about eighteen hours.

(*f*) While it is important that the diet and glandular secretions should be such that the feculent matter may have proper consistence, for easy propulsion along the intestinal tube, the important agent by which alvine evacuations are effected is obviously muscular contraction.

The muscular fibres of the intestines produce the vermicular and peristaltic movements by which the excrement is carried forward, and the abdominal muscles, by their powerful contraction, are the chief agents of expulsion. Now any pathological state which impairs the innervation of these muscles, or renders it abnormal, destroying the proper balance between "exciting and inhibiting impulses," is likely to cause constipation. Hence meningitis, myelitis, and certain other diseases of the cerebro-spinal axis, rachitis, general weakness, etc., are commonly attended by a sluggish state of the intestines, either from tonic contraction of the muscular fibres of the middle coat, as in meningitis, or paralysis.

Idiopathic Constipation. Causes.—These are quite numerous. The more prominent of them are the following. First, too little liquid in the excrement, so that it is too firm for ready evacuation. There may be too little liquid taken in the ingesta, or too scanty secretion of the liquids which mix with the food, as those of the pancreas, liver, and mucous follicles, or there may be too great an absorption of liquid through the coats of the intestines, and too active an excretion of water from the skin, kidneys, or lung. The firmer the fecal matter, the greater the tendency to constipation. Those who lose a large amount of water, as in diabetes, night sweats, or from occupations which expose to heat, or from residence in a hot climate, are especially liable to constipation, except as the loss of liquid is compensated by an increased amount of drink.

The character of the food, apart from the amount of liquid which it contains, obviously has a marked influence upon the consistence and frequency of the stools. Occasionally, the intestines act sluggishly from insufficiency of food. Thus, the infant sometimes hangs an unusually long time on the breast, and the mother or wet-nurse believes it to be a hearty nurser, when there is really a deficiency of milk, and the stools are scanty and infrequent from lack of material. Again, constipation is not uncommon in infants who nurse heartily, and seem to obtain a sufficient quantity of milk, and the cause of it is not in the state of the digestive organs, but in the milk. We find that now and then breast-milk has a constipating effect, although we discover nothing to cause this result in the mother's diet or health. The comparison of ordinary milk with colostrum may furnish a clew to the explanation. Colostrum is known to be more laxative than ordinary milk, and it differs from it chemically in containing more butter, sugar, and salts. Hence the theory seems plausible that, when breast-milk is constipating, these elements occur in less than the normal quantity. And we shall see hereafter that treatment suggested by this theory obviates the constipation.

The use of a diet which consists chiefly of assimilable substances, as animal food, and from which, after the digestive process, little coarse and stimulating residuum remains, is obviously liable to produce a sluggish state of the bowels. On the other hand, coarse food, as fruits with their seeds, coarsely ground meal, etc., which stimulates the peristaltic action and the secretions, increases the number and frequency of the alvine discharges.

Habit also exerts a decided influence upon defecation. One who, for

whatever reason, neglects or resists the desire for a stool, soon becomes less conscious of the daily recurring need, and establishes a constipated habit. Constipation is more liable to occur in those who lead a quiet life than in those who are active. A constipated habit is established in many school children, by neglecting or repressing the desire for a stool, during school hours.

But there are cases in which there seems to be a constitutional tendency to constipation—a tendency quite independent of the usual conditions. Thus I have met children who were bright and active, free from obstruction or disease which might retard the evacuations, apparently far from having sluggish muscular contractility, and so far as I could see with proper diet, and yet with defecation, except as it was produced by measures employed, occurring no oftener than each second, third, or fourth day.

But it must be borne in mind that what is constipation in one child may not be in another, for occasionally one does well with only one evacuation every second or third day, while a large majority require daily defecation, in order to the maintenance of perfect health.

In the adult, the sacculi or pouches which occur in the walls of the colon, produced by contraction of the longitudinal bands, acting at right angles to the direction of the circular fibres, and consisting of the internal and external tunics, without the muscular, become the receptacles for fecal matter in those who are constipated, and obviously tend to increase the constipation. In children these sacculi are much less developed relatively, and in young infants whose intestines lack the longitudinal bands, are absent, so that this anatomical condition by which the passage of fecal matter is delayed, is unimportant as a cause of constipation in the young.

Gautier, of Geneva, Switzerland, states that an anal fissure is a common cause of constipation in children. Pain in defecation when such a fissure is present might induce children to resist the desire, and postpone the act, and thereby establish a constipated habit, but if such fissures are common in this country, except in syphilitic infants, they have escaped our notice.

Constipation has a tendency to perpetuate itself, since retained feculent matter becomes more consistent and firmer, and the contractile power of the muscular tunic becomes weakened by long distention. Obviously, also, an abnormal length of the large intestine, so that it doubles on itself, whether congenital or the result of constipation, and a malposition, which diminishes the space occupied by the colon, and therefore increases its flexures, have a tendency to produce constipation.

Symptoms.—When there is a mechanical cause, which retards the passage of fecal matter, the acuteness of symptoms and the suffering are generally proportionate to the degree of obstruction. Symptomatic constipation occurring in an obstructive disease, whether adhesions, peritoneal bands, intussusception, knots or twisting of the intestine, incarceration in a false passage, or from biliary or intestinal stones, or fecal masses, is attended by severe symptoms, such as intense colicky pain, vomiting, loss of appetite, and rapid prostration. The ingesta accumulate above the point of obstruction, producing distention of the intestine

with fecal matter and gas, while below the point of obstruction the intestine is soon empty. The symptoms indeed have the severity, and the state involves the danger, present in ordinary strangulated hernia; while, from being internal and therefore less accessible for treatment, the danger is even greater. If the intestinal tract be narrowed, whether by a false ligament, the result of an old peritonitis, or other cause, and there be still perviousness, so that excrementitious matter passes by the obstruction, though slowly, and with more or less difficulty, the patient may be comparatively comfortable, if the food be such that no hard masses remain; but according to the degree of stenosis and the amount and coarseness of the fecal matter, symptoms occur referable to the obstruction. If the excrement be propelled with difficulty through the narrowed part, the muscular coat above the obstruction gradually becomes more developed, from hypertrophy of the muscular fibres, just as the heart enlarges from obstructive disease of its valves, while below the obstruction the intestine atrophies, and its calibre diminishes from disuse. Colicky pains, accumulation of fecal matter above the obstruction, distention of abdomen, eructation of gas, vomiting, impaired appetite, and consequent decline of the general health are common results. There is constant danger in these cases that the narrow passage may become obstructed by fecal matter, if it happen to contain hard masses, or coarse indigestible substances. The gravest form of constipation is obviously that due to mechanical agencies which act as obstacles, but as the obstacles are numerous, differently located, and of different character, so there is great difference in the gravity of the cases.

Idiopathic constipation generally comes on gradually. It at first attracts little attention and is neglected. The symptoms, of course, vary greatly according to the degree and stage of constipation. In mild cases, the retention is only in the rectum, or rectum and sigmoid flexure, and there are no marked symptoms except a sensation of fulness or distention of these parts, which one or two evacuations relieve. Between these mild cases and the graver forms of constipation, there is every intermediate grade, attended by symptoms proportionately severe. It is surprising sometimes to observe how long patients live with extreme constipation, though with constant suffering and ill-health, and, which I wish especially to be noticed in this connection, a large proportion of the fatal cases of idiopathic constipation occurring in adults, and recorded in the literature of the profession, began early in life, even in infancy, at which time they probably might have been relieved by proper medical measures, and a life of suffering prevented. This important practical fact shows the need of greater attention on the part of parents and nurses to the state of the bowels in children, that their sluggish action may be corrected before it becomes habitual, and those anatomical changes of distention and muscular paralysis occur, which are with difficulty corrected. Thus among the older authenticated cases is one related by Dr. Copeland, in his *Medical Dictionary*, from Renauldin.

Case.—A medical officer in the French service was always costive from birth, he ate largely, but seldom passed a stool oftener than once in one or two months, and his abdomen assumed a large size. At the age of forty-

two, his constipation was usually prolonged to three or four months. In 1806, after medicines had been taken to procure a stool, which had not been passed for upward of four months, abundant evacuations continued for nine days, and contained the stones of raisins taken a twelvemonth before; but the constipation returned. In 1809 the enlarged abdomen became painful, vomiting supervened, and he died at the age of fifty-four, having seldom, through life, passed more than four, five or six stools in the year. On opening the abdomen, a fibrous partition obstructed the rectum, about an inch from the anus.

A case quite as remarkable, and of recent date, occurred in the practice of Dr. Strong,[1] of Westfield, N. Y.

Case.—This patient, at the age of two years, usually had one stool in two weeks, and several years later only one in six weeks. When an adult he was treated by Dr. Strong, who found great distention of the abdomen, so that the lower ribs were pressed outward in nearly a horizontal direction, and the thoracic organs upward, so that the apex beat of the heart was about one inch above the nipple. At this time, months elapsed between the stools, the longest intervals being eighteen months and sixteen days. Defecation when it did occur lasted from two to four days, and was attended by violent gastric and intestinal pain, vomiting, and prostration. At one of these prolonged stools, forty pounds of feces, resembling, as it usually did, chewed brown paper, were evacuated, the quantity being accurately ascertained by weighing the patient before and afterward. He had appetite and was able to do certain kinds of farm work during the year preceding his death, which occurred at the age of twenty-eight years. At the autopsy the colon was found to have a length of six feet and three inches, and a circumference of thirteen inches, while the lungs were pressed upward and backward, as when compressed by a pleuritic exudation.

While such extreme cases are infrequent, all physicians of experience are consulted from time to time by adults who have had habitual constipation from their earliest recollection, and these cases, that aggregate so large a number, might, there is little reason to doubt, have been prevented for the most part during childhood, when the habit was being formed.

In long-continued constipation, in which there is a large fecal accumulation, not only is the diameter of the colon increased, as stated above, but this part of the intestine becomes elongated. This may lead to change in its position, the curves of the sigmoid flexure extending further to the right, and the central part of the transverse colon by its weight curving downward. This abnormal lengthening and the consequent curvatures have a tendency to increase the constipation, as has been stated above in our remarks relating to the etiology.

In these cases of extreme constipation, which fortunately are rare in children, as they are also in adults, the distention of the colon at the ileo-cæcal orifice has a tendency to widen this orifice, so that the valve which, in the ordinary state, prevents the return of any substance which has once passed by it, is liable to become insufficient. The adjacent

[1] Amer. Journ. of Med. Sci., 1874 and 1876.

folds which constitute the valve become separated, so that, if vomiting and antiperistaltic movements occur, fecal matter may pass from the colon toward the stomach. In aggravated cases, in which there is retention of a large amount of fecal matter, distention, muscular paralysis, etc., similar to those which we have seen produced in the colon, are liable to occur, though to a less extent, in the small intestines, especially in the ileum.

Retained excrementitious matter accumulating in large masses evidently becomes an irritant, so that, by its pressure, it excites muscular contractions, which, if ineffectual in propelling the mass, cause colicky pains. The retained fecal matter also undergoes more or less decomposition, producing gases which, by increasing the distention, also increase the pain.

Any irritating substance applied to a mucous surface is liable to excite increased secretion from the mucous follicles or from the glands whose orifices connect with the mucous membrane at the point of irritation. Many familiar examples will at once be recalled to mind, as the defluxion from the nostrils from the use of snuffs, and increased mucous secretion and salivation from objects held in the mouth. In the same way, retained excrement, forming hard masses which press upon the intestinal surface, excite a secretion, and not infrequently produce thereby a diarrhœa which is conservative, and which may for the time unload the bowels, or it may remove a part of the scybalæ, while the rest remain. Hence we sometimes hear patients speak of having irregular evacuations, constipation alternating with diarrhœa. In aggravated cases, the pressure of impacted feces sometimes produces inflammation of the surface, when, in addition to abdominal pain, there are tenderness on pressure and some, usually quite moderate, febrile movement. In cases which have terminated fatally, after a longer or shorter time, destruction of the mucous surface has been found in places, in consequence of the pressure and inflammation. Thus, in the history of the French officer related above, it is stated that the inner surface of the distended intestine "presented gangrenous and ulcerated patches." We can readily believe that, as in cases of typhoid ulcerations, if the ulcers reach a certain depth, they may also give rise to localized peritonitis, and that occasionally perforation may result at the ulcerated or gangrenous point. The expulsion of hardened masses which have collected in the rectum is slow and painful, and accompanied by more or less tenesmus, which not infrequently causes a portion of the mucous membrane at the anal orifice to descend below the sphincter ani and protrude, by which hemorrhoids are produced. Occasionally, as I have observed in certain cases, the entire circumference of the rectal mucous membrane, to the distance of half an inch or more above the anus, becomes so loosened from its attachment to the connective tissue that it descends below the sphincter ani, and protrudes during each defecation. But this displacement, known as prolapsus recti, more commonly results, in children, from protracted intestinal catarrh, attended by diarrhœa, loss of flesh, and by diminished tonicity of the tissues.

A beautiful and conservative provision in the system is that by which vicarious functions are established to relieve organs which imper-

fectly perform their part. While the intestinal surface is to a great degree eliminative, so that noxious and effete products are largely expelled from the system in the stools, it possesses also, in high degree, an absorbent function, as all who employ rectal alimentation are aware. Now, if the intestine fail to perform its function of defecation, and feculent matter collect within it, and begin to exert pressure upon the intestinal surface, more or less of the liquid portion is taken up by the vessels, and, entering the general circulation, finds a mode of escape through other emunctories. The general ill-health or languor, the furred tongue, headache, and foul breath which characterize these cases are, no doubt, due to the absorption into the blood, or retention in it of noxious products contained in, and which in part constitute, the feculent matter. The fact that patients may live for years with tolerable appetite, and with only one dejection every second or third week, receives explanation in the fact that other organs, as the lungs, kidneys, skin, etc., act as depurants for such excrementitious matter as can be taken up in a liquid or gaseous form by the intestinal surface.

In infants, constipation, even when slight and temporary, often causes fretfulness, which is indicated by the character of their cries and the movement of the thighs over the abdomen. Continuing for a time, it causes more or less fever, and, in those young children who are liable to eclampsia, it predisposes to an attack, and it may be the chief cause.

TREATMENT.—If there be reason to suspect the presence of a mechanical obstacle which prevents normal defecation, a careful examination should be made, in order to discover, if possible, its nature and location. Often it is of such a nature that it cannot be removed, but its constipating effects may sometimes be in a measure obviated. In the case related above, in which constipation continued from early childhood to adult life, and finally proved fatal, its cause was ascertained to be a septum in the rectum, which probably might have been relieved by surgical measures. In all cases of constipation, which the history shows may be produced by mechanical causes, whether the obstruction be complete and the colicky pains and other symptoms severe, or there be occasional scanty evacuations, with but slight or moderate suffering, the history of the patient should be obtained, in order to ascertain if there had been at any previous time symptoms of peritonitis or other pathological state which might throw light on the etiology. The abdomen and the usual sites of hernia should be carefully explored by palpation, and the rectum by the finger, large size catheter, or rectal tube. A thorough examination thus instituted, painless to the patient, will usually enable the practitioner to determine either the exact or probable obstacle, if any, be present.

The proper treatment of symptomatic constipation obviously requires the removal, so far as possible, of the primary disease, or the cause, whether it be obstructive or otherwise, and we need not stop to consider the special measures which are required, and will pass to the consideration of the treatment of idiopathic constipation.

Hygienic Measures.—We have already alluded to the fact that habit has a powerful control over the action of the intestines, so that it is im-

portant to obtain a daily alvine evacuation at a certain hour, and, by establishing the habit, the need will usually be experienced when that hour arrives each day. Many cases which become troublesome and obstinate might, no doubt, have been prevented, had this physiological law been heeded, and a daily evacuation obtained at a certain hour. The constipated habit, mild and not yet fully established, is more liable to be overlooked when it occurs in childhood than in infancy, for the infant is closely and constantly under observation, and it soon presents symptoms, as fever and fretfulness, if it do not have the regular evacuation, while children over the age of four or five years tolerate better a sluggish state of the bowels, and are likely to be constipated for a considerable time before it is ascertained. They therefore require more attention, in this regard, than is usually bestowed by parents.

The nature of the diet is obviously important, as certain kinds of food are more laxative than others. Chicken-tea, and, to a certain extent, beef and mutton tea, are laxative, and, made plainly, are, therefore, useful in connection with other articles. The various kinds of berries and fruits have also a decidedly stimulating effect on the intestinal surface, and aid in removing constipation. The apple scraped or baked, or apple-sauce, may be given to quite young children ; and for those that are older, currants, cherries, and, among dry fruits, prunes and figs are laxative. Unfermented cider, in its season, which has been found so useful for adults, may also be given to children in moderate quantity, at least to those who have reached the age of two or three years.

By the digestive process, starch, which is unassimilable, is changed into glucose, which can be absorbed and assimilated, and, from the small size of the salivary glands in the first months of infancy, it is believed that the salivary and pancreatic fluids are insufficient to convert starch into glucose except in very inadequate quantity. It appears, however, highly probable that there is an epithelial ferment, which converts starch into sugar[1], so that young infants can digest starchy food in limited quantity. The belief that the infantile digestion, up to a certain age, is inadequate to effect the change, led to the preparation of food for infants, in which the change of starch into glucose was accomplished by a chemical process. Now glucose, given in considerable quantity, is laxative, and I have found it necessary to give the glucose preparation sparingly, and with other food in the hot months, when infants are so prone to diarrhœa. But this laxative effect renders the glucose preparations of the shops very useful in the treatment of habitual constipation of infants, whether we employ the "maltose" or "granulated sugar of malt," or the preparations of Liebig's food. Of four constipated infants in the New York Infant Asylum, to whom Horlick's "sugar of malt" was given, three were relieved. Any of the glucose preparations can be given quite freely to a constipated infant, without impairing the digestive function, or producing other ill-effect, so long as no more than the normal evacuations are produced ; and I consider them among the best and safest of the foods for the relief of constipation in infants, but

[1] Chemical Phenomena of Digestion, by Charles Richet, Rev. des Sci. Méd., Oct. 1878.

glucose or grape sugar is only feebly laxative, probably not more than cane sugar.

Oatmeal is more laxative than most other kinds of amylaceous food. Made into a gruel and strained, it may be given to the nursing infant, and unstrained to those who are older. Bread or pudding from coarsely ground or unbolted flour or meal, and vegetables which contain saline and fibrous substances, have a stimulating and laxative effect on the surface of the intestines, and, therefore, are useful for constipated children of the age of two or three years and upward.

There can be no doubt that the free use of water in the ingesta materially aids in relieving costiveness. In one of the numbers of the London *Lancet*, a physician asks the profession how to cure obstinate constipation in adults. Among the replies, one physician suggests drinking a tumblerful of cold water on retiring to bed, and another tumblerful in the morning, and there can, I think, be little doubt that the laxative effect of broths, gruels, fruits, and mineral waters is partly due to the amount of water which they contain. One of the chief causes of constipation, we have seen, is too great firmness or consistence of the stools, due to absorption of the water, and if a larger quantity of water be swallowed during or after the meals than is removed by absorption, so that the stools have their normal or less than normal consistence, this cause of constipation is removed. An excess of water introduced into the system is to a great extent eliminated by the kidneys, and, in hot weather, by the skin, and, to a certain extent, exhaled from the lungs; but experience shows that, if the amount of liquid received be so great that the vessels in the coats of the intestines continue in a state of repletion, only a certain part of it is absorbed, while the rest descends and mixes with the excrementitious matter.

The simple expedient of allowing a liberal use of water, so useful in adult cases, doubtless also has a laxative effect in children, and its judicious use is proper for them. Another important aid in overcoming habitual constipation is frequent kneading of the abdomen. My attention was first particularly directed to this in the treatment of the case related above, in which obstinate constipation, occurring in a child of three years from peritoneal bands and adhesions, was to a great extent corrected by friction over the abdomen for three or four minutes at a time with cod-liver oil, three or four times daily. The manipulation probably did the good, and not the oil, but the use of one of the oils for inunction renders the kneading less painful, and insures its more thorough performance by the nurse. All obstetricians in certain emergencies stimulate the uterine muscular fibres to contraction by kneading the abdomen, and it is probable that the muscular fibres of the intestines are stimulated in a similar manner, so that the intestinal movements are increased by which feculent matter is carried forward.

The external application of cold, so effectual in contracting the uterine muscular fibres, also stimulates the contractile power of the muscular fibres of the intestines. Cold-water bathing, the sudden application of a cloth wrung out of cold water to the abdomen, and in certain obstinate cases even the douche, may be used to stimulate the muscular coat of the intestines and the abdominal muscles to greater activity.

Trousseau says: "Before leaving the subject of the treatment of constipation, let me refer to the application of cold to the abdomen—a minor method, which I have seen recommended, and have myself prescribed with astonishing success. On rising in the morning, let there be placed on the abdomen a compress of several folds soaked in cold water, and let it be separated from the clothes by a sheet of gutta-percha or caoutchouc. This compress ought to remain on for three or four hours." This recommendation by Trousseau is for adults, who are much less susceptible to the influence of cold than children. So prolonged an application of cold and wet to a child, even the most robust, would involve danger, while its application during the brief period occupied in an ordinary bath, with proper exercise afterward, or with other measures to prevent chilling, could have no ill-effect.

Therapeutic Measures.—For temporary constipation and many cases that are habitual, enemata should be employed, since they promptly unload that part of the intestines in which feculent matter is ordinarily retained, while they do not impair the appetite or produce the prostration which so often results from purgatives. For temporary constipation, a warm clyster may be given, and it commonly is more agreeable to the patient than one of lower temperature than the body. Among the enemata which have been found useful are castile soap, with molasses and water, salt and water, the various oils, as sweet oil, with or without castor oil, linseed oil, alone or with molasses, and the gruels, as that of oatmeal or cornmeal made thin. The belief that the frequent use of warm clysters produces a relaxing effect is probably correct, so that, if it be necessary to employ clysters often, in consequence of the torpid state of the intestines, cool water, the effect of which is tonic and stimulating, should be used.

For infants, a clyster of one or two ounces usually suffices, administered by a gutta-percha or glass syringe, while for older patients a proportionately larger quantity is required, administered by preference through a Davidson, India-rubber, or a fountain syringe. In certain long-continued, aggravated cases, the frequent injection of a large quantity of tepid water is indispensable, in order to wash away the accumulation of fecal matter. Thus, in 1854, Mr. Gay exhibited to the London Pathological Society a boy of seven years, who at the age of three years had had typhus fever with dysenteric stools. After convalescence, he had habitual obstinate constipation, so that, when Mr. Gay began treatment, there had been no fecal evacuation for nearly four months, and the girth of the body over the abdomen was forty-nine inches, and yet the appetite and general health were not seriously impaired. The shape of the abdomen and the examination showed great distention of the rectal ampulla and the descending colon. Mr. Gay first distended the sphincter ani, so that it admitted a speculum, and through a rectal tube, well introduced into the colon, the excrement was repeatedly washed away, so that at the time of the exhibition of the boy to the Society, the measurement in girth gave only twenty-four inches. Evidently in cases like the above, no other treatment except repeatedly washing out the intestines with warm water would have answered, and the dilatation of

the sphincter ani and the introduction of the speculum to facilitate the escape of fecal matter are noteworthy.

Suppositories may sometimes be usefully employed in place of enemata; cocoanut butter, molasses candy, or soap cut in shape of a pencil may be used for this purpose. In the adult, long-continued constipation is not very rare, in which the rectal ampulla becomes so impacted that it is necessary to use the anal curette, the handle of a spoon, or the finger introduced, in order to break up the masses, and allow them to pass. In children, necessity for such treatment is much more rare, but there are occasional cases like that above described by Mr. Gay, in which it may be needed. Dr. Nagel states that the evil may be removed by the introduction of a suppository of brown gelatine. This is steeped in water for twelve hours, and having been thus softened, is introduced into the rectum, and an evacuation obtained. The doctor attributes the laxative effect to the hygrometric action of the gelatine.

The known effect of the galvanic current in producing contraction of the uterine muscular fibres suggests its employment to relieve constipation, by stimulating the muscles of the abdomen and the muscular coats of the intestines, and those who have employed it speak favorably of its use. Habershon says: "A galvanic current, transmitted through the abdominal walls, induces a very speedy action, or rather emptying of the colon. . . . A case of partial paraplegia, in which injections did not act satisfactorily, and drastic purgatives were undesirable, was treated by a galvanic current passed through the abdomen every morning. In a few hours a free evacuation was produced without any discomfort." But the constipation of children very seldom requires the use of galvanism.

The ordinary purgatives should not be given habitually to relieve a constipated habit. They are liable to irritate the intestines, causing a catarrh, or else the intestines become accustomed to their action, and a large dose is needed to effect purgation. Given habitually, they cannot fail, also, to disturb the digestive and nutritive processes. One or two doses for present relief, both in habitual or temporary constipation, is sometimes required, provided that an injection is for any reason not preferred. For this purpose, castor oil or a few grains of calomel mixed with syrup of rhubarb, the syrup of senna, or the compound liquorice-powder of the German Pharmacopœia may be administered with advantage. But for habitual constipation I strongly advise to discard the ordinary purgative medicines, and if the measures of a dietetic or hygienic character, recommended above, are not sufficient, to employ such remedial agents as promote, or at least do not impair, nutrition.

Belladonna, so highly recommended by Trousseau and others, I have often administered to children, especially in pertussis, in large doses during several consecutive days, but it has not seemed to me to have any decided laxative effect. Though it may be useful in certain mixtures for adults, our experiences in this country, with reliable preparations, certainly have not been such as to justify its employment as the sole or main remedy for constipation. It diminishes reflex irritability, and may render the action of purgatives less painful, but from its known physiological effects we cannot believe that it increases the intestinal

secretions or the action of the muscular fibres, one or the other of which results we expect from the use of an agent which is really laxative. On the other hand, nux vomica and its active principle, strychnia, are doubtless valuable adjuncts to purgative mixtures, from their effect in increasing the action of muscular fibres.

Physicians are not infrequently at a loss what to prescribe for the habitual constipation of nursing infants, which is by no means infrequent. But recollecting that the colostrum is more laxative than ordinary milk, and that it differs from it in containing more sugar, salts (largely phosphates), and butter, we have a hint, as stated above, as to what is probably lacking in the milk, and what, therefore, should be supplied. I am in the habit of giving the oil, sugar, and salts in the following formula, and usually with the desired laxative effect:

℞.—Ol. morrhuæ . . . . . 2 parts.
Aq. calcis,
Syr. calcis lactophos. . . . . ãã 1 part.

One-quarter, one-third, or one-half teaspoonful may be given with each nursing, or a larger quantity, as a teaspoonful or more, three times daily. Breast-milk with this addition becomes more nearly like colostrum in its laxative properties, while it does not possess those properties of colostrum which disturb the digestive process. I know no agent of a medicinal nature which meets the indication so well as this for infantile constipation. But in my practice I have found it necessary, in not a few instances, to rely mainly on simple enemata for the relief of the constipated habit, till the infants reached the age when a mixed diet was proper.

The habitual constipation of older children may ordinarily be relieved by the remedies recommended above, but occasionally a more active purgative effect may be needed. Since the portion of intestine which is chiefly implicated in ordinary forms of constipation is the colon, it is evident that, if it be necessary to employ frequently any of the active purgatives of the pharmacopœia, such should be selected as produce little or no irritation of the long tract of the small intestines, while they stimulate the function of the colon. The aloetic preparations are preferable for this purpose, as the tincture of aloes and myrrh, or the simple tincture of aloes, which may be given in dose of part of a teaspoonful in a convenient syrup, or in coffee or milk.

CHAPTER XI.

INTESTINAL WORMS.

THE belief has been prevalent in the profession in former times, and *is* now among the people, that worms in the intestines constitute a frequent disease, especially in children. As pathology and the means of diagnosticating diseases are better understood, this idea has been gradually abandoned by physicians and the intelligent portion of the community. Still these parasites must be considered an occasional cause of serious derangements, and, in rare instances, a cause even of death. They indeed often exist in small number, without producing any appreciable deviation in the individual from the healthy state; but the most common and best known species, when they have once effected a lodgement in the intestines of man, ordinarily grow and multiply so as to produce symptoms, and require medicines for their expulsion.

So far as is now ascertained by observations in different countries, about fifty animal parasites make their abode in man. It is not improbable that the number will yet be found greater by observations in distant uncivilized countries. Of these fifty, twenty-one reside in the alimentary canal (Heller), several of them being microscopic. Of those occupying the intestines only, the following species are specially interesting to the practising physician, on account of their relation—for the most part causative—to certain pathological states, to wit: the ascaris lumbricoides, or round-worm; the oxyuris vermicularis, or thread-worm; the bothriocephalus latus, and three species of tænia, or the tape-worms, and the trichocephalus dispar, or whip-worm.

Ascaris Lumbricoides.—The round-worm has a dingy reddish or yellowish-red color and a cylindrical form, tapering toward both extremities from the point of its greatest diameter, which is a little posterior to the middle. The dead worm is paler than the living. The anterior extremity is tipped with three tips, between which and the body is a circular groove. Between these three tips anteriorly is the aperture of the mouth, from which the œsophagus extends to the distance of one-fourth to one-third of an inch. The intestine, which has a light brownish color, extends from the œsophagus to near the posterior extremity of the animal, where it terminates in the anus. The females are in numerical excess of the males, and their size is also greater. The shape of the worm is like that of the common earth-worm, from which it derives the name lumbricus, but it is somewhat more pointed and its color paler red. The tail of the male worm is curved like a hook, while that of the female is straight.

The total number of eggs contained in a fully developed female has been estimated at sixty millions. The eggs when immature are conical, and are attached to a longitudinal band; when mature they are oval,

with dark granular contents and a strong double shell, and their diameter is about $\frac{1}{500}$ of an inch. They are expelled in countless numbers with the feces, and at the time of expulsion are surrounded by an albuminous coating stained with bile. Their vitality is retained under apparently very unfavorable circumstances, even for years. They hatch after they have been repeatedly frozen or desiccated.

The ascaris lumbricoides inhabits the small intestines, where it is rapidly developed from the embryonic state. The remark made by Heller, that when found in the colon it is always dead, cannot be true, for many live worms are expelled in the stools.

The round-worm, more than all other intestinal worms, is inclined to wander away from its usual abiding-place, namely, from the jejunum and ileum, producing symptoms of more or less gravity, referable to the part over which it crawls. It occasionally enters the stomach, from which it is vomited, or it ascends the œsophagus into the fauces, from which it is soon removed by the efforts of the individual. Cases are on record, one of which Andral witnessed, in which the worm entered the larynx, producing suffocation and speedy death. Mr. Tonnellé also witnessed such a case. A child, nine years old, was suddenly seized with great difficulty of respiration and pain in the upper part of the chest. A careful examination of the thorax gave a negative result. Death occurred in from twelve to fifteen hours, and at the post-mortem examination a lumbricus was found filling the cavity of the larynx. M. Blandin, also, witnessed a case, when interne of the Hôpital des Enfants. An infant was suffocated by one of these worms, which had penetrated as far as the right bronchus. Very rarely they crawl from the fauces into the nasal passages. This worm is so strong and active that there is no recess or reflexion of the mucous membrane of the digestive apparatus which it could possibly penetrate, in which it has not been found. It has been discovered in the appendix vermiformis, in the pancreatic duct, in the common bile-duct, and even in the gall-bladder. The number of these worms found in the intestines is very various. There may be only one, or the number may be incredibly large.

Thus, Barrier relates the case of an infant thirty months old, who died in Hôpital Necker. It was believed to be tubercular. Numerous tumors, which could be felt in the abdomen, were supposed to be tubercular masses. On making the post-mortem examination, the mesenteric glands were found healthy, but the intestines throughout their entire extent were filled with lumbrici. The masses which, during life, were supposed to be tubercular glands, were found to consist of worms. The cæcum, especially, was greatly distended by them. The intertwining or collection in balls of these worms constitutes, indeed, one of the chief dangers, as it renders them so much the more difficult of expulsion.

The round worm possesses no organs of penetration; still, if the intestine be weakened by disease, especially by ulceration, it may, by pressure with its head, force an opening, through which it escapes into the cavity of the abdomen, causing peritonitis and death. This worm

is commonly found, whether single or in masses, surrounded by mucus, which serves as a partial protection to the intestines.

The portion of the mucous membrane in contact with lumbrici is often found inflamed, either from movements of the worm, or from pressure of a mass of worms, or even of a single worm in a confined position, as the appendix vermiformis. This inflammation, continuing and increasing, may end in ulceration, and thus a weakened spot be produced, which may be ruptured by simple pressure of the mouth of the worm. In this way are to be explained those apparent cases of perforation which have led some observers to believe that lumbrici have actually the power of penetrating the healthy coats of the intestines. The perforation is obviously most liable to occur in those who have been enfeebled, and whose tissues have been rendered less firm and resisting by antecedent disease, as by typhoid fever.

M. Guersant describes a case in which the appendix vermiformis contained an ulcerated opening, through which two round-worms had partly passed into the abdominal cavity, producing fatal perityphlitis. The effect of their impaction in this narrow cul-de-sac was much like that of a bean or seed lodged in the same situation.

The ascaris lumbricoides has occasionally been found in the most remarkable locations, namely, in abscesses lying without the intestines. They have been known to effect a lodgement in the liver, and produce an abscess there, no doubt by crawling up and distending a bile-duct. Their lodgement in other viscera, which have no pervious connections with the intestinal tract, is probably accomplished through fistulous openings produced by inflammation which they had no part in causing, as, for example, in the bladder and kidneys, of which there are well-authenticated cases. Worm cysts in the abdominal walls have been found to occur in most instances in the usual site of hernias, namely, at the umbilicus in children, and in the inguinal region in adults. It is presumed, therefore, that the worms had entered hernial protrusions, from which they had passed by ulceration into the abdominal walls, and had there become encapsulated.

The *oxyuris vermicularis*, or thread-worm, so called from its resemblance to pieces of ordinary white sewing thread, is also frequent in childhood, and not infrequent in the adult. The length of the male oxyuris is from one-sixth to one-fifth of an inch; that of the female from one-third to one-half an inch. The posterior extremity of the male is blunt, and is curved, or rolled up, toward its abdomen; that of the female is slender and pointed like an awl.

The head of this worm is relatively broad, from an unusual thickness or fulness of the cuticle, and the mouth, surrounded by "three nodular lips," is situated in the centre of the extremity. The œsophagus extends backward from the mouth, gradually growing larger, like the segment of a long and narrow cone, and ending in a globular enlargement, which has been designated the pharynx. From the pharynx the intestine runs in nearly a straight line through the worm.

The eggs are numerous, so completely filling the interior of the female as to conceal the organs from view. They are flattened on one side, but are rounded or convex on other parts of their circumference. One end

is more pointed than the other, as in the eggs of birds. Certain of the eggs in the mature female are seen to be undergoing segmentation preparatory to hatching, while others more advanced contain tadpole-shaped embryos, and others still contain worm-shaped embryos, either lying within the shells or protruding from them. The hatching and growth of this worm, which have been observed under the microscope, are very rapid under favorable circumstances. "I once," says Heller, "saw the metamorphosis from the tadpole-shaped embryo to the worm-shaped embryo completed in about one hour," but the usual time is longer. Leuckhart saw oxyurides, one-fourth of an inch in length, fourteen days after the eggs had been swallowed.

Oxyurides may be developed so rapidly from eggs swallowed in the ingesta, that they attain nearly or quite their full growth while still in the small intestines, so that, although their chosen residence is in the large intestines, some of them are not infrequently found in the ileum, and even in the jejunum, of full size and active. The part of the intestinal tract which the oxyurides prefer, and in which the largest colony of them reside, is the cæcum and appendix vermiformis, and not in the rectum, as stated in most of the books, and in this situation, where they have been little disturbed, their habits and the relative proportion of the sexes can be best observed. But they are ordinarily found both in the cæcum and rectum in the same individual, and, indeed, upon all parts of the intervening surface of the colon.

The number of oxyurides in the individual varies greatly. They are occasionally so numerous upon the intestinal surface that they resemble fur, and when they are so abundant they are commonly found above the ileo-cæcal valve as well as below it. The males are smaller and apparently more fragile and perishable than the female. Therefore in the rectum and other exposed situations, there is a numerical excess of the females; but in reflexions of the intestines, where they are securely lodged, as in the appendix vermiformis, no marked difference has been observed in the relative number of the two sexes. Since the males are more delicate, transparent, and smaller than the females, they are more likely to be overlooked in a hasty post-mortem examination.

The term *tape-worm* is applied to several species of the tænia, and to at least two species of the bothriocephalus, but all except four, to wit, the tænia solium, tænia saginata or medio-canellata, tænia elliptica or cucumerina, and the bothriocephalus latus, are rare in Europe and North America, and are therefore of little interest to the practising physician.

The tape-worm is an hermaphrodite, each segment containing the two sexual organs. The head, or scolex, is small, about the size of a pin's head, and segment after segment is produced by a budding process from the head. The segments are attached to each other at their extremities, and each segment as it becomes further and further removed from the head, by the formation of new intervening segments at the upper end of the chain, becomes also larger and more matured. The oldest segments having attained their full growth, are detached, and have an independent existence. A separation of the chain of segments at any point does not compromise the life of the parasite. If only the head

remain uninjured the segmentation continues from it, and in time the former number of segments and former length of the chain are restored. This worm resides in the small intestines, the larger species sometimes extending from the upper part of the jejunum to near the ileo-cæcal valve.

The *tænia solium* is developed from an embryo, known as the cysticercus cellulosæ, contained in the muscles of the hog. It has also been found in some other animals, as the dog, deer, and polar bear. It is a vesicle, about the size of a pea or small bean, having a delicate cell-wall, and is nearly spherical, except as its shape is changed by compression between the muscular fibres. At one point of the cell-wall is a depression, attached to the inner surface of which, and lying within the cyst, is a whitish, pear-shaped, solid body, which is the head of the cysticercus, and is identical in appearance and character with the head of the tænia solium turned inside out. Many experiments have shown the close relationship of the cysticercus and tænia solium, that they are two forms of existence of the same parasite. Segments of the tænia solium have been repeatedly fed to pigs, and the cysticercus produced in their muscles, though in what way the ovum or embryo passes from the stomach to the muscles is not known. On the other hand, swine flesh containing cysticerci has been fed to animals who were soon after killed, when the tænia was found in their intestines. It is evident that this parasite occurs only in those who eat swine flesh, as sausages, either raw or but slightly cooked.

The head of this species of tænia, which is about the size of a small pin's head, has at the top a conical protuberance, upon which is a corona of hooklets, arranged in two circles, the hooklets of the outer circle being smaller than those of the inner. The projecting points, however, of the two rows fall together, forming one circle. The hooklets are inserted into depressions in the head, and many of them have fallen out in most specimens which we have an opportunity of examining. The depressions in which the hooklets are lodged are often dark from pigmentation. Back of the circle of hooks are four sucking disks, which the worm is able to protrude and move freely. When protruded they appear as small tubercles with slender pedicles. The neck, which is slender and about one inch in length, shows markings from commencing segmentation, and it is succeeded by very small and delicate segments, which gradually increase in size as the distance from the head increases.

The mature segments (proglottides) vary in size accordingly as they are in a state of contraction or relaxation. When relaxed, their length is about half an inch and breadth one-quarter of an inch. The genital organs are situated on the margin of each segment, a little posterior to the middle, and there is an alternation in their location between the right and left margins in the chain of segments. The uterus lies in the centre of the segment, forming a longitudinal straight line. From seven to twelve branches are given off from each side of the uterus, and these divide and subdivide like the branches of a tree. The male genital organs lie in the same aperture or pore in the margin of the segment, with which the uterus and ovaries connect.

The eggs of the tænia solium are globular, with a diameter of about $\frac{1}{750}$th of an inch, and with thick shells, which are striated like Mosaic work by lines which cross each other. It is estimated that not less than 50,000,000 eggs are contained in all the segments of a matured tænia.

This parasite is very liable to abnormal development. In some instances two or more segments are fused together, and often they are stunted in their growth, or they contain holes, fissures, and flaws, either from their original development, or produced by rupture of the distended uterus. Again, rarely two tænia are blended, so that along the flat side of one chain another is united by the margin, so that a section of the double parasite resembles the Roman letter T or Y. The nutrition of the segments is maintained through a vessel running the whole length of the worm, near each margin, and having communicating branches.

The *tænia saginata*, designated also *medio-canellata*, is much larger, stronger, and thicker, both as regards the head and segments, than the tænia solium. When fully matured it measures eighteen feet. The diameter of the head is nearly one line ($\frac{9}{100}$ inch). It is furnished with four strong sucking disks, but it lacks the circlet of hooks which characterize the tænia solium. Instead of the hooks the head is furnished with a small frontal sucking disk. The heads of some specimens of this worm are free from pigment, but other specimens present various shades of pigmentation—from a slight staining to a jet black color. The neck is short, and very near the head are markings which indicate commencing segmentation. The matured segments vary in measurement when relaxed—from a length of eight lines and breadth of two lines, to a length of nine lines and breadth of three lines. As in the tænia solium, the genital pores are situated on the margins of the segments, varying irregularly from side to side, and the uterus has lateral branches, which divide dichotomously. There is but little difference in the sexual apparatus of the tænia solium and tænia saginata, but the eggs of the latter are somewhat larger than those of the former, and are oval.

The development of the tænia saginata is sometimes irregular, producing monstrosities, as in the tænia solium. The embryos of this parasite occur chiefly in the muscles of ruminating animals, as the ox, sheep, goat, etc., and therefore its presence in man is attributable to the use of the flesh of these animals, either slightly cooked or raw. The cysticercus of this species appears to be less tenacious of life than that of the tænia solium, and when it perishes it becomes changed into a greenish-yellow pulp, surrounded by the capsule, and imbedded in the muscular or other tissue where it had lodged.

It is easy to distinguish this worm from the tænia solium if the head be found, by its larger size, the larger size of its sucking disks, and the absence of the circle of hooks. The segments are distinguished by their greater size, and the greater number, and the dichotomous division of the branches of the uterus. This species occurs over a much greater area of the earth's surface than the tænia solium.

The *tænia elliptica* or *cucumerina* is a more delicate worm than the preceding species, measuring, when fully grown, from seven to ten or

eleven inches in length. Upon its head is a rostellum or beak, which the worm is able to thrust forward, and on which are about sixty hooks, irregularly arranged. The anterior portion of the parasite is very delicate, like a thread, and its segments are small, but, as in the other species, they become larger as their distance from the head increases. The matured segments which have a reddish-white color are readily detached, and when separated they move about actively. This tænia is also an hermaphrodite, and a genital pore containing a double set of genital organs is located on each margin of the segment. The tænia elliptica inhabits the small intestines of the dog and cat, and many children in different localities have been affected with it.

Heller states that the segments of another and rare species of tænia, which were expelled from a child of nineteen months, are preserved in the Museum of Pathological Anatomy in Boston. Nearly in the middle of the posterior half of each segment, is a yellow spot, namely, the receptaculum, full of ova, and, therefore, the name flavo-punctata has been applied to this worm. Little is known in regard to the tænia nana and tænia Madagascariensis, since they occur in distant countries.

The *bothriocephalus latus* is the largest of the tape-worms, attaining the length of 15 to 24 feet. It is one of the most important of the intestinal parasites. The head has an almond-shape or the shape of an elongated and somewhat flattened globe, its length being about one line, and its diameter from one-third to one-half a line. Running longitudinally along each flattened side of the head is a groove or fissure, containing the apparatus of suction. Those segments which are still in the process of growth, have a breadth three or four times greater than their length, while the matured segments are nearly square. The genital pore occurs in the centre of one side of the segment, and in the chain of segments all the pores are found on the same side. A brownish, rosette-shaped spot is observed at the site of each ripe pore produced by the convolutions of the uterus, and the numerous eggs which this organ contains.

The egg, which is oval, has a thin shell, a light brown color, and at one end of it is a lid or operculum, which is separated from the rest of the egg by a well-defined line. At the hatching an embryo, provided with six hooks, escapes from the lid. When it has separated from the egg it is provided with an albuminous covering, from which cilia radiate in all directions, by the movement of which it is propelled. After a few days this covering is lost, and the embryo now moves about by amœboid extension and contraction. It is believed that in this embryonic state it enters an aquatic animal, a mollusk or fish, where it undergoes further development, and from which it is received into the stomach in the food.

The bothriocephalus occurs not only in man, but also in some of the domestic animals which eat fish, as the dog. This parasite is believed to be rare outside of Europe, and in Europe it is chiefly met in countries bordering on inland lakes and seas.

The *trichocephalus dispar* is comparatively unimportant to the physician, since it is uncertain whether it materially impairs the health or produces symptoms. It inhabits the cæcum, but in rare instances it has been found in the ileum and appendix vermiformis. The number of

these parasites is usually small, but as many as seventy to one hundred have been observed in the intestine of the adult.

The trichocephalus dispar occurs also in the monkey, and a very similar, if not identical, worm has been found in the pig. It is not frequent in children, and it has not been observed in very young children. It occurs in man in every part of the globe, and in some countries, as Egypt, Nubia, and Syria, it is said to be very common. This worm, which is also sometimes designated the whip-worm from its shape, attains the length of one and a half to two inches, the female being longer than the male. Its anterior two-thirds are thin, delicate, and flexible, like a small thread. The posterior one-third, which contains the generative organs and intestinal canal, is considerably thicker, and it ends abruptly. On the under surface, extending nearly the whole length of the body, is a longitudinal band, the width of which is about one-third the circumference of the body. In the female, the posterior or thick portion of the worm is slightly bent or curved like the stock of a hunting-whip, while that of the male is rolled in the spiral form. The digestive tube consists of an œsophagus, which extends through the anterior thread-like part, and the stomach and rectum which lie in the posterior thick division. The genitals of the female lie in the commencement of the thick portion, and the uterus, when distended with eggs, occupies nearly the whole of this section. In the male, the pore, which contains the genitals, lies in the posterior extremity of the thick part, where it forms a cloaca with the termination of the intestinal canal. The eggs, which are numerous, are oval, brownish, and with a glistening protuberance at each extremity, giving them the shape of a lemon. They have great vitality, hatching after repeated desiccation and freezing. Their development from the egg is slow. It is believed that the trichocephalus is produced directly from the egg, which has lodged in the intestine, and, therefore, does not have or require an intermediate stage of preparation in another animal. This parasite resides in the cæcum, but when many are present, some are found in the ascending colon, and occasionally a few are observed in the small intestine.

The tænia is rare in early life, but it now and then occurs in young children. I have met cases in this city under the age of five years. Rosen and Bremser report cases between the ages of six and eleven years, and Hufeland one at the age of six months. Wawruch collected 206 observations of tænia, in 22 of which the age was less than fifteen years; the youngest was a girl of three years. A most remarkable case of tænia is reported in the *Gazette Médicale* of Paris in 1837. M. Muller was called to treat a foster child five days old for slight constipation. The bowels were evacuated by the use of rhubarb, manna, and a few grains of salt, and in the excrement a foot and a half of tænia were discovered. This worm had evidently existed during the fœtal life of the infant.

A similar case was treated by Prof. Skene, in the Long Island Hospital, in September, 1871, and reported by Dr. Armor.[1] The infant was born September 3d, of a hearty Irish servant girl. On the 7th it

[1] New York Medical Journal.

refused to nurse, and was observed to have a mild form of tetanus. On the 8th small doses of calomel having been given, followed by castor oil, two segments of a tænia solium were passed from the bowels, and on subsequent days ten more segments, after which the tetanus ceased. The remedies employed after September 8th were the oil of male fern and turpentine. The mother, who had presented no symptoms of tænia, was ordered an emulsion of pumpkin seeds, which "she faithfully took for twenty-four hours, at the end of which she passed over seventy segments of tænia." This case is interesting as throwing light on a possible mode of the production of tænia, quite different from the ordinary and recognized mode, and also as showing the causative relation of intestinal worms to tetanus infantum.

Causes.—It is obvious that intestinal worms are developed from eggs or embryo, which are introduced into the stomach in the ingesta. The eggs of the ascaris lumbricoides have been found by Mosler[1] in drinking water, but it is probable that in most instances they are contained in fruits and vegetables which are eaten raw. The eggs of the oxyuris vermicularis are received from some one who is himself affected with the disease. Both Zender and Heller state that they have frequently discovered ripe eggs of this worm around the nails of persons who were troubled with oxyurides, a fact readily explained from the itching which they cause. If these eggs are upon the fingers of the mother or nurse, it is easy to understand how they are acquired by the child. We can understand also why this worm is so common in degraded and filthy families. In reference to the etiology of the tape-worm nothing need be added to what has been stated above, and little is known in reference to the manner in which the eggs of the trichocephalus are received.

Certain conditions of the intestinal surface favor the occurrence of worms. Thus children in advanced typhoid fever are not unfrequently affected with the ascaris lumbricoides.

Symptoms of the Ascaris Lumbricoides.—These are in part constitutional, and in part local, due to the mechanical effect of the entozoa on the coats of the intestines. Writers, especially Rilliet and Barthez, have described with minuteness the symptoms supposed to indicate lumbrici. Those of a constitutional character are the following: Features at one time flushed, at another pallid, and in some children of a leaden hue; lower eyelids swollen, and sometimes surrounded by a blue semicircle; thirst, nausea, or even vomiting; appetite diminished or augmented, or variable; breath foul; papillæ of the tongue red and projecting; pulse accelerated and irregular. Rilliet and Barthez state that they observed this irregularity of the heart's action in a boy three years old, at the time he was passing a large number of lumbrici. The irregularity afterward disappeared. Acceleration of the pulse and increase in temperature are common symptoms of these worms, and hence the popular belief in a worm fever. This fever is often remittent and mild, but occasionally it is continuous and of a high grade.

The symptoms pertaining to the nervous system are important. In mild cases these may be absent, as when there are few lumbrici, and

[1] Virchow's Archiv, 1860.

the child is robust, and over the age of five years, but in severe cases certain neuropathic symptoms are frequently present, such as dilatation of the pupils, especially inequality of dilatation, to which Munro attached diagnostic value, strabismus, twitching of the muscles, clonic convulsions, somnolence, headache, neuralgic pains, delirium. Rarely chorea, deafness, and paralysis, it is believed, may result.[1] Dr. Leedom,[2] of Montgomery County, Pa., relates the case of a boy of seven years, who had night-blindness due to a large number of lumbrici in the intestines. By the employment of pinkroot and calomel these were expelled, and the blindness ceased. Hyperæsthesia of the abdominal surface was present in a case which I attended, and which subsided as soon as the lumbrici were expelled. Grinding the teeth in sleep, and picking the nostrils, are symptoms to which families attach great value. Observations, however, show that, though sometimes due to worms, they more frequently have another cause.

The local symptoms or disorders, in other words, those having a mechanical origin, are colicky pains, experienced chiefly in the umbilical region; stools sometimes natural; in other cases diarrhœa with fecal or muco-sanguineous stools; flatulence. M. Davaine, at a recent period, made the important discovery that the feces of patients affected with worms contain the ova of the particular species present, in large numbers. These ova, which have been described above, can be seen through a lens magnifying 150 diameters.

In exceptional cases there are local symptoms, due to the presence of these worms in unusual situations, such as a crawling sensation in the œsophagus; a sense of constriction in this tube or the pharynx; nausea and vomiting; a cough, especially if the worm have crawled to the upper part of the œsophagus; rarely the most urgent dyspnœa, and probable suffocation, if a lumbricus have entered the larynx. Earache, and perhaps convulsions if the worm have entered the Eustachian tube (Case, Davaine, p. 144). The most dangerous symptoms arise from the crawling of the worm into narrow openings.

The enteritis and colitis, to which these worms sometimes give rise, are ordinarily mild, but in rare instances ulceration occurs, which may be attended by profuse and even fatal hemorrhage. Occasionally very painful and dangerous constipation results from an accumulation of worms, in a ball or mass too large to be expelled, unless with much delay and suffering, preventing the passage of fecal matter, and producing severe abdominal pains. The symptoms in these cases resemble closely those of intussusception. A marked example of constipation produced in this way occurred in a family with whom I am acquainted, and who then resided in the interior of this State. A little girl of three or four years was suddenly affected with obstinate constipation. The physicians prescribed active purgatives, calomel among others, and finally croton oil, and various injections, without relief. There was great pain with distention of the abdomen, and death seemed inevitable,

[1] Gaz. des Hôpitaux, 1867.
[2] Amer. Journ. of Med. Sci. for July, 1867.

when, after the lapse of several days, a free evacuation occurred, and in the stool was a mass of worms firmly intertwined.

Children often have lumbrici without any appreciable impairment of the general health, but their presence may intensify the symptoms of intercurrent diseases, and greatly increase the danger. Thus I recollect two children of three and three and a half years, with pneumonitis, who, at the same time, had lumbrici, one passing in the course of a few days thirty and the other twelve of these entozoa. Both presented well-marked physical signs of pneumonitis, and, though they recovered, the febrile movement and nervous symptoms were apparently aggravated by the intestinal affection. One had convulsions in the commencement of the inflammation, followed by profound stupor and amaurosis, lasting two or three days.

Often the symptoms due to lumbrici coexist with those of a protracted and distinct intestinal disease. Thus, as we have seen, the intestinal secretions of typhoid fever and of chronic diarrhœal maladies afford a nidus for the growth of worms, and accordingly, at an advanced stage of these diseases, lumbrici are common.

The symptoms produced by the *oxyuris vermicularis* are somewhat different. These worms do not usually cause the fever, disturbed digestion, the colicky pains, or the dangerous nervous symptoms which arise from the presence of lumbrici. Nor do they, like lumbrici, endanger life by crawling into unusual situations. In one recent case, I could detect no other cause of chorea than the presence of oxyurides, and eclampsia has been attributed to them, but such a result is exceptional, if, indeed, the cause be rightly assigned.

Although the cæcum is the chosen abode of this worm, and here more than elsewhere it exists in its normal state, it is not certain that it produces any appreciable symptoms in this part of the intestinal tract.

The symptoms which render this the most annoying of all the intestinal parasites are produced by these oxyurides, chiefly the females, which descend into the rectum, where by their active movements they produce intense itching. A small number of worms cause little inconvenience, but when many are present in the folds of the rectum their crawling produces such intense pruritus that the patient can with difficulty remain quiet. Usually this symptom is most marked in the early evening, when the child is warm in bed. It sometimes causes onanism in the girl as well as boy. This symptom may be nearly or quite absent during the day, but it returns so regularly at night as to resemble and be mistaken for a periodical nervous affection. So eminent a physician as Cruveilhier confesses that he has made this mistake of diagnosis. In the female child the oxyuris occasionally passes from the rectum to the vulva, producing leucorrhœa.

In many instances tapeworms exist in children as well as adults, who thrive and present no symptoms, but in other instances there is more or less disturbance of the digestive function, with an uncomfortable sensation in the abdomen. This sensation is more noticed after fasting, or after the use of certain kinds of food, and it is diminished by a full meal. Great hunger and a feeling of faintness are also common according to authorities, but I have not particularly remarked them in children.

Irregular action of the bowels, vomiting, and various nervous symptoms, as itching of the nostrils, and anus, headache, tinnitus aurium, cardialgia, numbness, deafness, blindness, etc., have with more or less correctness been attributed to the tape-worm. Certainly such symptoms occasionally arise from this cause, for they cease with the expulsion of the worm.[1] Intermittent colicky pains in the umbilical region were the only marked symptoms in a child with tænia whom I recently treated. Since the cysticercus cellulosæ is the embryonic form of the tænia solium, it is quite possible that individuals possessing the latter may be infected from its ova with the former, so that symptoms which have been attributed to the intestinal parasite, have sometimes been due to the encysted embryo. We are unacquainted with the symptoms of the trichocephalus if any occur, and this worm is very rare in children.

Diagnosis.—Bremser long since made the remark, and it has been repeated by most writers on diseases of children, that there is no sign or symptom which affords positive proof of the presence of intestinal worms, except the expulsion of one or more. Late microscopic investigations have revealed, however, a pathognomonic sign, namely the presence of ova in the feces, which indicates not only the nature of the disease, but the species of the worm.

The symptoms and disorders produced by lumbrici may all occur from other causes. Still, if several of them be present, and a careful examination disclose no other cause, the presence of worms should be suspected, provided that the child be over the age of two years. The microscope may then be used for diagnosis. A little tentative treatment, entirely safe to the child, will also determine whether the suspicion be correct. One or two doses of medicine, administered under such circumstances, like the surgeon's exploring needle, may reveal the nature of the disease, and indicate the means of cure.

In case of the oxyuris vermicularis, the itching directs attention to the anus as the place of the disease, and here the offending entozoa may often be discovered by the eye.

Prognosis.—Intestinal worms produce a fatal result in only a small proportion of cases. Oxyurides never prove fatal, unless in rare instances, through convulsions. The manner in which death may be produced by lumbrici has already been pointed out.

In general, when the nature of the disease is ascertained, the worms are readily expelled by treatment, and the patient restored to health. Therefore, if there be no complicating disease, the prognosis is good.

Treatment.—Much injury has been done to children by the use of anthelmintics occasionally employed by physicians, but oftener by parents before the physician is called. Medicines of this kind are usually irritants, and, in many of those diseases which simulate the verminous affection, but are distinct from it, there is already an irritated if not an inflamed state of the intestinal mucous surface.

Vermifuges administered under such circumstances obviously do harm, and in all acute diseases in which they are not required, even if their action be harmless, their employment is to be regretted, since it

[1] Medico-Chir. Rev., January, 1868.

consumes time which is very precious. It is thus that many lives are lost by the use of anthelmintic nostrums, which are extensively advertised and which command a ready sale, inasmuch as the belief in the presence of worms as a frequent cause of disease pervades all classes.

A safe rule, followed by many physicians, and it would be much better if it were general, is not to give anthelmintics unless the child have passed one or more worms, or their ova be found in the feces, and not then if the symptoms seem to be referable to a coexisting disease. In doubtful cases in which the symptoms resemble those of worms, a purgative dose of calomel or calomel and rhubarb may be employed. It will generally bring away one or more lumbrici or a mass of ascaris vermicularis, if either species of entozoa be present. This purgative may be safely employed if there be no previous diarrhœa or debility. If after one or two doses and a free purgation no worms be passed, anthelmintic remedies should not be given, for it is almost certain that none exist.

A large number of medicines have, or have had, a reputation as anthelmintics. Santonin, the active principle of the European wormseed, is one of the best, and is much employed in this country and in Europe. It is nearly tasteless; it may be given in powder, spread on bread with butter. It is kept in shops in one or two grain lozenges, with and without calomel. It has the advantage of easy administration, and is destructive to both the round and thread worm. M. Bouchut considers it preferable to all other remedies in the treatment of the round-worm. "To children two years of age he administers it in doses of ten centigrammes (1.54 grains), and in patients above this age the quantity is increased by five centigrammes (0.75 grain) for every additional year." He gives, in addition, occasional doses of calomel or castor oil. In this country santonin is usually administered in one to three-grain doses, two or three times daily, with an occasional purgative. The purgative is required to aid not only in the expulsion of the worm, but also of the ova. In overdoses santonin causes vomiting, diarrhœa, and altered vision, so that objects appear yellow, but in medicinal doses it produces no unpleasant consequences. Other medicines are preferable if there be symptoms of enteritis. For many years the anthelmintic most employed in this country was the pinkroot, the root of the *Spigelia marilandica*, an indigenous plant. It was not only prescribed by physicians, but employed by families as a domestic remedy. It is liable to cause, if the dose be large, cerebral symptoms, as vertigo, dimness of sight, spasm of the facial muscles, stupor, and even convulsions. These effects less frequently occur if the pinkroot be given with a purgative, and it has been customary to administer it in combination with senna in an infusion. A half ounce of spigelia with an equal quantity of senna is macerated for two hours in a pint of boiling water, and then strained. For a child two or three years old the dose is half an ounce to one ounce. So popular has this vermifuge been in this country, that probably a majority of the native-born adults in the States recollect the nauseating doses of pinkroot administered by anxious parents. Pharmacy now provides us with the same

medicine in a more convenient and acceptable form, that of the fluid extracts:

℞.—Fluid ext. spigel. . . . . f℥j.
Fluid ext. sennæ . . . . . f℥ss.—Misce.
One teaspoonful to a child from three to five years.

The officinal fluid extract of spigelia and senna may be given in the same dose. Professor Procter recommends the addition of santonin to this extract:

℞.—Fluid ext. spigel. et sennæ . . . . . f℥j.
Santonin . . . . . gr. viij.—Misce.

This is probably the best anthelmintic that can be employed for the destruction of the round-worm in uncomplicated cases, and it is also very useful in treating the ascaris vermicularis. Chenopodium is also a good anthelmintic. It is efficient, and at the same time one of the safest in case the mucous membrane be inflamed. If there be abdominal tenderness, with stools too frequent, and thin, or mucous, and tinged with blood, I should prefer the chenopodium to most of the other vermifuges. To a child of three years five drops of the oil may be given three times daily. It may be continued for a longer period than would be safe for most of the other vermifuges. Twice a week, during its use, a mild purgative should be given, as castor oil, rhubarb, or magnesia, unless the bowels are open. It may be given dropped on sugar, or in a mucilaginous mixture.

Dr. J. F. Meigs says: "I myself rarely give any other remedy than *wormseed oil* in slight and especially in doubtful cases, unless this has already been tried and failed. From my own experience, I believe that this remedy is all-sufficient in a large majority of the cases that occur in this city, as these are almost always of a mild character, and as it not only produces the expulsion of the parasites when they exist, but also acts beneficially upon the forms of digestive irritation which simulate so closely the symptoms produced by worms. I am persuaded, indeed, that of all the cases that have come under my notice, in which it seemed probable that worms might be present, none were expelled in nearly half, and yet the signs of disturbed health have passed away under the use of the remedy." . . . . "The following is a very good formula for the administration of this remedy:

℞.—Ol. chenopodii . . . . . gtt. lx vel f℥j.
P. g. acaciæ . . . . . ℥ij.
Syrup. simplic. . . . . ℥j.
Aq. cinnamom . . . . . ℥ij.—Misce.

"Give a dessertspoonful three times a day for three days, and repeat after several days."

In cases of protracted intestinal disease attended by an increased and vitiated secretion from the mucous surface, a state which often gives rise to worms, turpentine is one of the best anthelmintics. In fact, in some of these cases there is no good substitute for it. For example, a boy of about ten years, attended by myself, October, 1864, had reached or nearly reached the fourth week of typhoid fever, when he passed

from his bowels a large quantity of blood. He was previously emaciated and weak, and there had been, as is usual in such cases, considerable diarrhœa. The hemorrhage was attended with great prostration, from which, however, he partially rallied by the use of stimulants. On the following day an equally severe hemorrhage occurred, attended with coldness of the face and extremities and great feebleness of pulse, so that death appeared imminent. Turpentine was now administered every six hours, a few lumbrici were passed, and the case thenceforth progressed favorably. The mechanical effect of the lumbrici on the ulcerated surface of intestine had probably given rise to the hemorrhage. Turpentine may be given in doses of from five to ten minims three times daily to a child five years old. Sweetened milk or sugar in powder is a good vehicle for it, or it may be given in a mucilaginous mixture.

℞.—Spts. terebinth. rect. . . . . ʒij.
Ol. limonis . . . . . gtt. v.
Mucil. gum acac.,
Syr. simplic. . . . . āā ʒvj.
Aq. anisi . . . . . ʒj–ij.—Misce.
Dose, one teaspoonful every six hours.

The following formula for the employment of this agent is recommended by Dr. Condie:

℞.—Mucil. gum acac. . . . . ʒij.
Sacch. alb. . . . . ʒx.
Spir. æther. nitr. . . . . ʒiij.
Spir. terebinth. rect. . . . . ʒiij.
Magnes. calcinat. . . . . ℈j.
Aquæ menthæ . . . . . ʒj.—Misce.

It is useless to enumerate the many anthelmintic mixtures which have been extolled from time to time. Those mentioned above are the least nauseous, and will rarely disappoint the practitioner. One other antidote for the round-worm should be mentioned, as it has been much used and is efficient, namely, cowhage. This consists of the bristles which cover the pods of the *Mucuna pruriens*, a tropical plant. The pods are dipped in plain syrup of the ordinary consistence, and the bristles are scraped off with the syrup. When enough of the medicine is added to render the syrup of the consistence of thick honey, it is ready for use. The dose is a teaspoonful every morning for three days, after which a cathartic should be administered. I have never prescribed cowhage, although it is not unfrequently ordered by physicians, and a popular nostrum consists chiefly of it.

One affected with tapeworm is obviously cured only when the head of the parasite is expelled; but, in the majority of cases which I have observed, the head has not been found in the evacuations, even when the treatment had effected a complete cure, as shown by the subsequent history. The chain of expelled segments commonly terminated very near the head. This I believe is the common experience if we trust the friends of the patient with the examination of the stools. The physician himself should search for the worm's head, the evacuations being

preserved. The nurse should be directed to add a little carbolic or salicylic acid, and a sufficient quantity of water nearly to fill the vessel. The liquid should not be roughly stirred with a stick, as physicians are in the habit of doing, since this breaks the worm into small portions, and renders the inspection more difficult, but it should be shaken frequently so as to detach the segments and head, if it be present, from the fecal matter. After it has stood at least five to ten minutes, the worm, which has greater specific gravity than water, sinks to the bottom, and the upper part should be poured off. This process must be repeated till the water is nearly colorless, after which search should be made for the fragments, and the head, if present, will be found.

Since entire expulsion of the tape-worm is effected with difficulty, preparatory treatment for about forty-eight hours should be employed before the vermifuge is administered. During this time the patient should take a mild purgative once or twice, and such food, in moderate quantity, should be allowed as leaves little residuum, as beef-tea, milk, etc., with some stimulant, if the patient feel exhausted. There are three articles of food which experience has shown to be especially useful in this preparatory treatment, perhaps from a sickening effect which they produce upon the worm, namely, salt herrings, onions, and garlic. They may, therefore, be taken as food in the twelve or eighteen hours preceding the employment of the vermifuge, which it is ordinarily most convenient to administer in the morning.

The various tænicides recommended in the books are probably all more or less efficient, but the one which has given most satisfaction in the Outdoor Department at Bellevue, where probably a larger number of these cases are treated than in any other place in this country, is the oil of male fern; but it is found necessary to employ a larger dose than is recommended in some of the books. For a child of six years the dose employed is one drachm in any convenient vehicle, as the syrupus aurantii florum. This should be followed in about four hours by a dose of castor oil, which completes the treatment. Heller, a high German authority, recommends koosso or its active principle koossin, in the use of which I have had no personal experience. The pumpkin-seed has also been employed at Bellevue and in other parts of this city, but it seems to be less efficient than the oil of the fern. If the chain of segments break near the head, and the head be not seen, it will be necessary to wait two or three months, in order to determine whether the cure is complete.

Since the symptoms produced by the *oxyuris vermicularis* are referable chiefly to the rectum, and are caused by the active movements of the worm, the prompt and thorough use of enemata, which causes their expulsion, is evidently required. Enemata are more effectual if used cool than if warm; and since this worm inhabits the cæcum as well as rectum, large enemata given through a long tube or a large catheter are more effectual, causing the expulsion of a larger number of worms than are expelled by small enemata employed in the usual manner. Various substances have been used for this purpose, as lime-water, table salt in water, turpentine in milk, decoction of aloe, decoction of garlic, etc. Heller says: "Simple water would do well for this purpose, for

in a short time it causes the worm to swell up and burst; but that is not altogether without an injurious effect on the intestinal mucous membrane. Hence, Vix recommends a solution of castile soap, in distilled water, or rain-water, of the strength of one to two and a half grains to the ounce. This has no unpleasant action on the intestinal mucous membrane, while at the same time it quickly destroys both the worms and their eggs. . . . . Vix has tested all the medicines usually used in enemata, and has found the above solution of castile soap to be the most effectual." The use of the enema in the evening, although only a small quantity of liquid be used, so as to wash out the rectum, insures relief from the itching and sleeplessness during the night.

But it is undeniable that enemata alone do not effect a complete and permanent cure in a large proportion of cases, and hence those affected with this worm remain sufferers for years, having only a temporary respite, unless medicines be administered by the mouth. Those medicines which produce free watery evacuations appear to be the most effectual in dislodging and expelling oxyurides, whose attachment to the intestinal surface is not strong; therefore Heller recommends the saline purgatives "joined with copious draughts of water."

CHAPTER XII.

GASTRO-INTESTINAL HEMORRHAGE.

HEMORRHAGE from the capillaries is more frequent in infancy than at any other period of life, whether in consequence of the irregularity of the circulation and frequent congestions in the infant, or the greater delicacy and feebleness of the minute vessels at this age. Hemorrhage, generally capillary, from the gastro-intestinal mucous surface, occurs sufficiently often in the child, and especially in the infant, to render it a disease of some importance. It is more frequent the younger the individual.

This hemorrhage occurs in three distinct pathological stages: first, in the newborn infant from causes not fully ascertained; secondly, from a pathological state of the blood or the vessels in which it circulates, and which is often connected with purpura hæmorrhagica; thirdly, from a local cause.

First Variety.—In 49 cases, which I have collected from different writers, the hemorrhage occurred in 38 under the age of six days, in 5 from six to ten days, and in 6 from ten to twenty days. Some authors cite cases which occurred at the age of several weeks, but hemorrhage into the intestines at so late a period cannot be due to any cause oper-

ating at birth, and it is proper to consider such as examples of one of the other varieties.

Passive congestion of the gastro-intestinal mucous membrane is not infrequent in the newborn. Billard speaks of twenty-five cases without hemorrhage which he has examined. This anatomical state of the mucous membrane of the intestines, whether occurring as a part of a general plethora or being simply a local affection with no hyperæmia of other parts, evidently requires only a certain increase and hemorrhage results.

The cause of the abnormal congestion of the gastro-intestinal mucous membrane, so common in the newborn, has been referred by writers to the previous health of the parents, to circumstances attending the birth, especially to too speedy a ligature of the cord, to irritant matters in the intestines, to external violence, and to the two opposite extremes, namely, a plethoric and a feeble state. In my opinion, the chief cause, in many cases, is the tardy or incomplete establishment of the respiratory and circulatory functions, which gives rise to congestion in the cavities of the heart and in the lungs, and, consequently, in the capillaries throughout the system. Evidently, this congestion is most intense in the full-blooded. Billard says of fifteen cases of intestinal hemorrhage which he examined, most of them were remarkable for the plethoric condition of their bodies and the general congestion of their integuments. Some, on the contrary, were pale and feeble, as is common after abundant hemorrhage.

In two infants who died soon after birth, and whose bodies I subsequently examined, there was apparently a plethoric state, which rendered a fatal result more certain, if it did not, indeed, produce it. In one of these, in addition to intense general congestion, meningeal apoplexy had occurred, although the birth of the child had been easy.

It is not difficult to understand in what way too speedy a ligature of the cord may be a cause of capillary congestion and hemorrhage. At the moment of birth, the uterus is contracted, the placenta compressed, and, if the cord be now tied, more blood remains in the vessels of the infant than if tied a little later. A little later, in consequence of the temporary cessation of uterine contractions, and the reëstablishment of circulation in the infant, blood flows through the cord toward the placenta. The cord thus acts as a safety-valve to the circulation. Any accoucheur who will take pains to witness the effect on the cord of the return of circulation, will observe what I have stated. Too speedy a ligature of the cord would not, however, be sufficient in the majority of cases to produce that amount of plethora which gives rise to intestinal hemorrhage without other coöperating causes.

Tardy or incomplete establishment of respiration and circulation, which gives rise to intestinal congestion and hemorrhage, may be due to disease of the heart or lungs, as atelectasis or cyanosis, to feebleness of the infant, or to slow and difficult birth. In a large proportion of cases, however, the birth is easy. Thus, three of five patients with intestinal hemorrhage, who were treated by M. Gendrin, were born of an easy labor, and the same was true of four infants observed by M. Kiwisch.

Although gastro-intestinal hemorrhage in the newborn apparently results in certain instances from the conditions mentioned above, which produce congestion of the gastro-intestinal mucous surface, there are other cases in which the cause must be different. Dr. Silverman,[1] of Breslau, has recently published the statistics of 42 cases, 23 of which were fatal. In 25 of these the blood escaped both from the mouth and anus, in 10 from the anus alone, and in 7 from the mouth alone. The hemorrhage, in a majority of the cases, began on the second day after birth, but in 11 it began on the first day, and in all prior to the eighth. It is suggested that the hemorrhage, in certain instances at least, occurs from an ulcer in the gastro-intestinal surface, which is produced by an embolus in the umbilical vein, or its branches, or by suspension or incomplete establishment of the respiratory function in consequence of accidents of birth, atelectasis, etc. Ebstein, according to Silverman, has demonstrated experimentally that the suspension of respiration in animals produces congestion, extravasation of blood, ulceration in the stomach. From the fœtal anatomy, it is evident that an embolus occurring in the umbilical vein near the liver, and extending into the branches of the vein, would be likely to cause congestion of the intestines by obstructing the portal circulation.

Dr. Lederer[2] states that he has treated eight newborn infants for this disease, five of which died from the severe gastric and intestinal hemorrhage, accompanied also by umbilical hemorrhage. The age of the youngest was six hours. That of the oldest eleven days. They were all well developed, of normal conformation, and were nourished with breast-milk. In the three who were cured, the hemorrhage was arrested in twenty-four hours, but there was for a long time a tendency to intestinal catarrh. Dr. Lederer admits the obscurity of the cause, but does not think that it was an embolism in all the cases.

The *second* variety of gastro-intestinal hemorrhage often occurs as a sequel of other and debilitating diseases. I have known it to occur as a sequel of measles, smallpox, scarlet fever, and in one case of typhoid fever. One of these patients, when apparently the period of danger was passed, began to lose blood from nearly all the mucous surfaces, from the nostrils and gums, as well as intestines, and the case, which but for the hemorrhage would doubtless have had a favorable issue, terminated fatally in less than a week.

Patients with this variety of gastro-intestinal hemorrhage sometimes present the maculæ of purpura, and commonly their aspect is pallid and cachectic. The following was a fatal case of hemorrhage occurring from the ileum, in a mild form of purpura hæmorrhagica.

Case.—An infant, eight months old, of healthy parentage, nursing, with no previous sickness, and fleshy, vomited a small quantity of blood on the 25th of March, 1865; soon after it passed a stool consisting of almost pure blood. On the following day five or six patches of purpura hæmorrhagica were observed on the arms and legs. These maculæ continued till death. There was no more hæmatemesis, but the stools, which were from two to

[1] Jähr. für Kinderh., Sept. 1877. [2] Zeitung für Kinderh., Nov. 1877.

four daily, consisted largely of blood. Death occurred from exhaustion on March 31st.

Sectio Cadaver.—Head not examined; thoracic organs healthy, but pale; liver fatty; stomach, upper part of small intestines, and entire colon of normal appearance, unless presenting a somewhat lighter color than the healthy intestine from deficiency of blood; mucous membrane in the ileum, to the extent of several inches, intensely injected without thickening. The blood had obviously escaped from this portion of the intestine, and a moderate amount of this fluid was found in the tube below the point of vascularity. This case is interesting not only on account of the development of purpura hæmorrhagica, but because of the subsequent intestinal hemorrhage in a nursing child, apparently of healthy parentage, and without previous sickness.

In our remarks on internal convulsions, the case is related of a scrofulous infant, who, to all appearance in her ordinary health, suddenly became affected with intestinal hemorrhage in connection with external and internal convulsions. A point of interest in this case was the relation of the hemorrhage to the neurosis. In one of the three cases of intestinal hemorrhage described by West, there were also convulsions. In rare instances there is an hereditary hemorrhagic diathesis to which the hemorrhage is attributable. The late Prof. Swett[1] relates the history of a hemorrhagic family. Seventeen out of eighteen children of this family had died of hemorrhages, and the survivor had had intestinal hemorrhage with epistaxis.

In the *third* variety, among the local causes producing hemorrhage may be mentioned ulceration, as in typhoid fever, or in severe intestinal inflammation, the mechanical effect of solid substances, lumbrici, invagination, obstruction to the portal circulation, polypus of the rectum. Occasionally at the post-mortem examination of young infants I have found blood with mucus in the duodenum and jejunum, these portions of the intestines being at the same time intensely congested. In one case of protracted entero-colitis occurring in the summer season, I found many small circular ulcers in the colon, nearly all containing points of extravasated blood. Such are the principal local causes of hemorrhage from the bowels. Ordinary colitis may also be considered a cause, although the amount of blood evacuated in this disease is commonly small.

Of the three forms of intestinal hemorrhage described above, that arising from local causes is most frequent, while that occurring from a purpuric or hemorrhagic diathesis is least frequent. In rare cases fatal intestinal hemorrhage may occur in the newborn, and the blood be retained in the intestine, or if passed it may so closely resemble the meconium that its true nature is not discovered. Mr. Bednar[2] relates the following case: "On the eleventh day after birth the boy's skin (then of a pale yellow color) diminished in warmth, the impulse of the heart became dull and prolonged, the respiratory murmur scarcely perceptible. The child lay almost motionless and slumbering. The day

[1] New York Journal of Medicine and Surgery, July, 1840.
[2] Krankheiten der Neugeborüen.

following the surface could scarcely be kept warm, and the little patient had to be aroused to suck. On the twentieth day after birth it died. The brain was found to be anæmic, the lungs plethoric, while the blood was effused into the duodenum and stomach."

Intestinal is more frequent than gastric hemorrhage, and the flow, except when produced by a local cause, is usually from the small intestines. The blood, unless it come from a point near the anus, as the rectum or descending colon, is commonly dark, and sometimes partially decomposed, emitting an offensive odor. Admixture of the blood with the intestinal secretions prevents coagulation of the fibrin.

Gastro-intestinal hemorrhage in itself produces few symptoms aside from the prostration which attends all hemorrhages. The disease with which it is associated may give rise to many and severe symptoms.

Prognosis.—The result in the first and second varieties is much more unfavorable than in the third. Many newborn infants affected with gastro-intestinal hemorrhage die, but some recover. Billard attended fifteen fatal cases. It is probable, however, that death in the first variety is often due more to some coexisting lesion, than to the intestinal hemorrhage. Meningeal apoplexy, and the incomplete establishment of the circulatory and respiratory functions, may both operate as direct causes of death in this variety.

In the second variety, also, a very guarded prognosis should be given; so great a change in the circulatory system as to cause rupture of the capillaries, or transudation of blood in the ordinary course of the circulation, is a serious state. When this hemorrhage occurs as a sequel of the eruptive fevers, or in purpura hæmorrhagica, the patient is more likely to die than recover.

In the third form of intestinal hemorrhage, the result depends on the nature of the cause, whether it be susceptible of removal. The majority of cases in this variety recover.

Treatment.—Billard recommends, as a means of preventing capillary congestion and hemorrhage in the newborn, to allow a little blood to escape from the umbilical cord before its ligation, if the establishment of respiration and circulation be difficult or incomplete. This relieves the hyperæmia of the internal organs and facilitates the flow of blood. After the commencement of internal hemorrhage and the appearance of bloody stools, the same may be done if plethora be indicated by the florid and robust appearance of the infant, and the cord be not too much shrivelled.

The treatment both therapeutic and regimenal, of intestinal hemorrhage, should vary according to the age and state of the infant, the profuseness of the hemorrhage, and the nature of the cause. Perfect quietude, in the recumbent position, is requisite in all severe cases. Derivation to the extremities should be procured in the young infant, by heated dry flannel or flannel wrung out of hot water; in the older infant, by the same with the addition of mustard. The nursing infant should remain at the breast, being allowed, perhaps, in addition to the breast-milk, a little cool barley or gum-water. Spoon-fed infants should be given food of the blandest quality, in the liquid form and cool. This is the proper diet, whatever the age, in the commencement of the hemor-

rhage. If there be evidence of exhaustion, cool beef-tea, or essence, and alcoholic stimulants, are necessary. It has been advised, in certain forms of intestinal hemorrhage, to apply leeches over the abdomen or around the anus. This treatment would, in my opinion, rarely be useful, but, on the contrary, in most cases, injurious. Hemorrhage from a mucous surface, which, when once established, generally quickly relieves the local hyperæmia, and leeching will, unless very cautiously employed, promote the prostration, in which the real danger in this disease consists. On the other hand, moderate counter-irritation over the abdomen may be attended with real benefit as a derivative.

The therapeutic treatment consists mainly in the use of astringents. Of the mineral astringents, acetate of lead and nitrate of silver have been used, but the liquor ferri subsulphatis is preferable to all other astringents in hemorrhage from the stomach and upper part of the small intestine, but it is believed to be decomposed in its passage through the intestine, so that it has less astringent or styptic effect in the lower bowel than gallic acid. It may be given to a child five years of age, in doses of five drops, in sweetened water or in mucilage.

Astringent enemata are sometimes useful. M. Rilliet treated a case which recovered with enemata, each containing twelve grains of extract of rhatany, a strong decoction of the same astringent being applied externally to the abdomen. M. Bouchut recommends "cold water externally to the abdomen, internally by the mouth, or by enemata frequently repeated. These enemata should be composed of two or three large spoonfuls only. They may be rendered more active with three grains of tannin, or with seven grains of the extract of rhatany or seven grains of catechu, or, lastly, with one grain of nitrate of silver. In this latter case, a small glass syringe and distilled water must be used, to avoid the premature decomposition of the medicine."

In the hemorrhage occurring in purpura, or after exhausting constitutional diseases, tonics should be given in addition to astringents. In chronic inflammatory disease of the intestinal mucous membrane, attended by a vitiated secretion of the follicles, the hemorrhage may be best treated by turpentine. I have elsewhere related two cases of recovery by the use of this agent, in one of which (typhoid fever) lumbrici were expelled. Ergot, from the contracting influence which it exerts on the arterioles, is also useful in many cases. It is especially useful in purpura hæmorrhagica.

If the hemorrhage be due to a local cause, as lumbrici or a rectal polypus, the treatment obviously should consist in the removal of this cause.

CHAPTER XIII.

INTUSSUSCEPTION.

Intussusception, or the passage of one portion of intestine into another, has long been known as an occasional accident. Hippocrates, though debarred from the study of morbid anatomy, appears to have had a pretty clear idea of this lesion, and he suggested a mode of treatment which has been employed till the present time.

Intussusception without Symptoms.

This is not properly a disease. It consists in a displacement without any other anatomical change. There is, therefore, no obstruction, inflammation, or even congestion present, and no symptoms. This form of invagination might ordinarily be reduced by the normal peristaltic and vermicular movements of the intestine.

Invagination of a portion of the small intestine into the part immediately below it is often observed at the post-mortem examination of young infants, who had presented no symptoms due to the displacement. The invaginated mass is usually from half an inch to two inches in length, and, as a rule, this accident is multiple. There may be ten or more distinct intussusceptions, at distances of a few inches from each other. The simple displacement is believed to occur ordinarily at or a short time prior to the moment of dissolution. It has been supposed to be most frequent in those who have died of cerebral or spasmodic diseases, but its occurrence is not unusual in other pathological states. I have often found it at the post-mortem examination of infants who have had subacute or chronic entero-colitis. Heven states that he has seen it at the Salpétrière more than three hundred times. Billard has seen it especially in infants who have been subject to constipation. Any irritant, mechanical or other, which disturbs the regular movements of the intestines, doubtless may produce it. It has been caused in the rabbit by irritating the anus.

It is not improbable that simple intussusception occasionally occurs temporarily in children whose health remains good, when the regular movements of their intestines are disturbed by irritating ingesta or other causes. This form of displacement never takes place in the large intestine. It usual seat is the lower part of the jejunum, and upper part of the ileum. Since it possesses little interest as regards pathology, and none whatever as regards symptomatology and therapeutics, it may be ignored in our description of intussusception.

Intussusception with Symptoms.

Intussusception, or invagination, is one of the most painful and dangerous of human maladies, but fortunately is not very frequent. I have the records of fifty-two cases occurring in children, from which the facts contained in this article are chiefly derived. The patients were under the age of twelve years.

Previous Health.—In thirty-four of the fifty-two cases, the state of the health previously to the invagination was recorded. From the following table it is seen that half, or seventeen, were previously well, the remaining half suffering from some disease or derangement:

	Previous Health.	
Age.	Good.	Disease or Derangement.
One year or under	15	8
Over one year	2	9
	17	17

MM. Rilliet and Barthez, whose views in reference to intussusception are derived from the examination of the records of twenty-five cases, state that the previous health is ordinarily good, and the intussusception is, therefore, primary. Their remark, according to the above statistics, is seen to be correct as regards patients under the age of one year, but incorrect for those over that age.

Most of the seventeen who had previous ill-health had diarrhœa, dysentery, or constipation, or diarrhœa alternating with constipation. Of those otherwise affected, one had thread-worms, two obscure abdominal pains, one nausea and vomiting, and one, whose age was four months, had had symptoms of invagination when ten weeks old, which soon passed off. It is seen that the preëxisting affections were ordinarily such as would be likely to accelerate the movements of the intestines and at the same time render them irregular.

Causes.—The above statistics, therefore, show that intussusception is often preceded by disease or functional derangement of the intestines. The two opposite conditions, namely, constipation and the diarrhœal maladies, so often precede the displacement that they must be regarded as common causes. Another probable cause is intestinal worms, which, by their mechanical action, stimulate the intestines. They were present in three of the fifty-two patients, though two of the three seemed well till the occurrence of the intussusception, but the other patient had complained of irritation at the anus, and ascarides had been found on examination.

The use of irritating and indigestible food is an occasional cause. Thus, some who have had intussusception have been in the habit of taking fruits, candies, and pastries freely. Such ingesta may be an immediate cause by their irritating effect, or a remote cause giving rise to diarrhœa, which, in turn, produces intussusception.

Sex is a predisposing cause, since male patients are largely in excess. Of the twenty-five cases collated by Rilliet and Barthez, all but three

were boys. In our own collection, the sex of thirty-four of the patients was recorded, and of these twenty-three were boys.

In rare instances external violence is the apparent exciting cause. One patient received a severe contusion of the abdomen two years before death, and from this time continued to complain at intervals of pain in the bowels. One writer also mentions the case of a child nine years old, who received a blow from a comrade at school, and from this time had alternately diarrhœa and constipation till the invagination commenced. Rilliet and Barthez also relate the cases of two children who were taken suddenly with invagination when their parents were tossing them in their arms.

AGE.—Of the fifty-two cases embraced in our statistics, the ages were as follows:

3	were	3	months	old.	1	was 10 months old.	
12	"	4	"	"	1	" 11 "	"
3	"	5	"	"	1	" 12 "	"
5	"	6	"	"	2	were from 1 to 2 years old.	
1	was	7	"	"	8	" " 2 " 5 "	"
1	"	8	"	"	8	" " 5 " 12 "	"
3	were	9	"	"	3	not given.	

Therefore, no cases occurred under the age of three months, 23 cases were between the ages of three and six months, or nearly one-half of the entire number, 8 between the ages of six months and one year, and only 18 between the ages of one year and twelve. These statistics correspond, in the main, with those of Rilliet and Barthez, in whose collection of twenty-five cases no one was under the age of four months. Leichtenstern[1] says: "Half of all invaginations, according to my statistics of four hundred and seventy-three cases, occur during the first ten years. The first year after the third month is remarkable for a special frequency—one-fourth of all intussusceptions."

The great liability to intussusception in infancy is due partly to the anatomical character of the intestine in this period of life, and partly, doubtless, to the fact that there are more frequent irregularities in the intestinal movements than in older children. In the infant the walls of the intestines are thin, the mucous and muscular coats and the connective tissue being much less developed than in those that are older; the mesentery and meso-colon have also greater depth as compared with the same in other periods of life, except the meso-colon at the points where it passes over the kidneys, in which places it is very short, or even in some cases nearly absent. Moreover, the space occupied by the large intestine, in which part of the digestive tube intussusception commonly occurs, is much shorter relatively to the length of the intestine than in those that are older. In about thirty measurements which I have made of the length of the large intestine and the space occupied by it, the latter was found, on the average, about one-third that of the former, which, of course, necessitates doubling of the intestine on itself. These peculiarities of structure in the infant obviously favor the occurrence of intussusception.

[1] Ziemssen's Encyclop.

Seat and Pathological Anatomy.—While intussusception occurring without symptoms is usually multiple, that form which occurs with symptoms is ordinarily single. Two exceptional cases which I observed will be presently related. In one of the cases embraced in the statistics an invagination occurred with symptoms, and coexisting with it was another in the small intestines apparently without symptoms, and quickly reduced by handling.

While intussusception without symptoms occurs in the small intestine, the seat of intussusception with symptoms is, with occasional exceptions, the colon. The colon constitutes the entire invaginated mass, or else, and more frequently, it forms the exterior, while the incarcerated portion consists wholly or in part of the ileum.

Intussusception in the Small Intestines.

Bouchut says: "M. Rilliet states, in a recent treatise, that in infancy the intestinal invagination is always accomplished at the expense of the large intestine, and that there is never invagination of the small intestine. This is incorrect. I have observed the small intestine invaginated in the adjacent inferior part. Taylor has reported a case of this kind in a child twenty months old, who died after an attack of acute peritonitis. M. Marage has seen another case in a child thirteen months old, who recovered after having voided the invaginated portion furnished with two of those diverticula so frequent in the small intestine of the fœtus."

But, from all that appears, the case reported by M. Marage may have been, and probably was, an example of the common form of intussusception, namely, of the ileum into the colon. In Mr. Taylor's case the invagination was really of the ileum into the colon, although a small portion of the ileum next to the valve had not been inverted, so that it constituted a little of the exterior of the mass.

Nevertheless, Bouchut is correct in stating that irreducible and fatal intussusception may occur in the small intestines. Probably the displacement is at first of the simple variety, but, continuing and increasing in extent, its return becomes impossible. The positive statement of so great an authority as M. Rilliet, that intussusception with symptoms does not occur in the small intestines, justifies the publication of the following cases, which establish the fact that there are instances, though not frequent, in which the displacement does have this location:

Case I.—Male. This patient's health had been uniformly good, and nothing unusual was observed in his condition till the age of four and a half months, when he became restless, as if in almost constant pain, with occasional exacerbations. Castor oil was prescribed, which operated freely, and then the following mixture:

℞.—Magnes. calcinat. . . . . ℈j.
Tinct. opii camphorat. . . . . ʒij.
Tinct. asafœt. . . . . ʒss.
Aq. anisi . . . . . ʒj.—Misce.

Dose, ten to twenty drops, repeated according to the pain.

These remedies failed to give relief, as did also chloroform given in doses of two drops. After two or three days, another set of symptoms arose, those characteristic of pneumonitis, to wit, hurried respiration, accelerated pulse, short suppressed cough, and expiratory moan. He was treated with the oiled silk jacket, and mild counter-irritation, and took an expectorant mixture containing ammonium carbonate. In a few days the pulmonary disease was evidently subsiding, but the pain in the abdomen, with occasional exacerbations, continued. His countenance was pallid, and bore an expression of suffering. There was no distention or tenderness of abdomen, and no abdominal tumor. He took little nutriment, and seldom vomited. In the last part of his sickness the dejections were scanty, and the last three days his stools consisted mainly of mucus and a little blood. The pain seemed to be growing less, when he was seized with convulsions, and died the same day, precisely two weeks from the commencement of his sickness.

Sectio Cadaver.—Head not examined; body slightly emaciated; mucous membrane of trachea and bronchial tubes vascular; posterior portion of the lower lobe of each lung solid, of greater specific gravity than water, and allowing only partial inflation; it was in the second stage of pneumonitis. Stomach, duodenum, jejunum, healthy. In the upper part of the ileum was an intussusception two-thirds of an inch long, presenting no trace of inflammation, either within or around it, and its vascularity, when it was examined externally, did not seem notably increased. Above

Fig. 36.

the intussusception the intestine was empty; below it, and chiefly in the small intestine, was a dark-colored substance evidently blood, and giving in a few hours the offensive odor of decaying animal matter. There was a passage through the intussusception, at least two or three lines in diameter, as shown by a probe. The intussusception sustained the weight of sixteen inches of the intestine, and it would apparently have sustained considerably more. The remaining organs were healthy.

Case II.—F. S., a female infant, four months old, was treated at the New York Infant Asylum in June and July, 1865, for entero-colitis, the

usual epidemic of the summer season. The following records show the state of the bowels immediately before her death:

June 29th. Has five or six stools daily. 30th. Two stools in twenty-four hours. July 1st. Had two stools since the last record; no vomitines 3d. Four stools in last twenty-four hours. 4th. The diarrhœa continug. as before; the stools about four daily. On the 6th of July she died.

Her pulse during the time in which these records were taken generally numbered about 128 per minute. She was much emaciated, and the day before death she frequently struck her head with her hand. The medicines employed were mainly alkalies and astringents.

Sectio Cadaver.—Parietal bones united; serous effusion over the convolutions of the brain, under the arachnoid; occipital bone depressed; commencing at a point about two feet below the stomach were four intussusceptions two or three inches from each other. The invaginated masses were from one to one and a half inches in length, and three of them were found to be very vascular in their interior. Above, between, and immediately below the intussusceptions the intestine was healthy. One of the invaginations was tested by weight, and was found to sustain a foot and a half of intestine, and would have sustained more. Water poured above these intussusceptions escaped through them very slowly; no fibrinous exudation; descending colon vascular and thickened, and solitary glands enlarged.

The irreducible character of the intussusceptions in the above cases was shown by the fact that they sustained weights which doubtless produced greater traction than that exerted by the intestine in its normal action. That the displacement existed prior to the moment of death was shown by the symptoms in one of the cases and by the anatomical changes in both. In one the capillaries of the incarcerated mass were ruptured during the last days of life, so as to produce sanguineous stools; while in the other there was intense congestion of the invaginated mucous membrane, while that portion of this membrane which was adjacent but not engaged was healthy.

In both patients the symptoms were less severe than in ordinary cases, and they came on more gradually, for the invaginated intestine was not completely closed, so that it allowed the passage of fecal matter in one till the close of life, and in the other till near its close. At both of the autopsies water poured into the intestines above the invaginations passed slowly through them.

Intussusception in the small intestines in the infant, commencing as the simple form, may become irreducible, and yet remaining pervious may continue for weeks without giving rise to severe or dangerous symptoms. The following case was an example of this:

Case.—Male child, died at the age of nineteen months, the last eleven of which he was under observation. The mother states that he had never been well since the age of one month, and that there had been little variation in the symptoms of his disease. During the period in which he was under observation, he was ordinarily fretful, and frequently seemed to be in considerable pain. His stomach through this whole time was so irritable that he rarely took more than three or four spoonfuls of nutriment without vomiting. There was usually more or less diarrhœa, but no tenderness or distention of abdomen. He became slowly but gradually more

emaciated, and finally died in a state of extreme emaciation and exhaustion. He had no convulsions, and was conscious to the last.

Sectio Cadaver.—Brain not examined; lungs healthy, except a circumscribed portion which was inflamed at the summit of the right lung; liver small and almost destitute of oily matter, as shown by the microscope. In the jejunum, about two feet below the stomach, was an intussusception two inches long, the intestine forming which seemed to have undergone no structural change. Above the intussusception the intestine was of small calibre, and entirely empty and pale; below the intussusception the intestine was somewhat larger than above, but it seemed quite healthy. The invagination was sufficiently pervious to allow water to pass through it, and it readily sustained the weight of two feet of intestine. From eight to ten inches below this intussusception there was another, which was immediately drawn out the moment the intestine was disturbed. The other abdominal viscera were healthy.

There is uncertainty as to the duration of intussusception in the above case, but the symptoms indicated that it existed a considerable time prior to death. There was no strangulation, nor indeed any appreciable anatomical alteration in the coats of the intestine, but the fact that the invaginated mass sustained two feet of intestine, and required considerable traction for its reduction, shows that it was not a case of simple displacement occurring at the moment of death and without symptoms, but was an example of the variety with symptoms.

Intussusception in Large Intestines.

In most cases of intussusception occurring in infancy and childhood, the ileum is invaginated in the colon, or the first part of the colon is invaginated in the part succeeding it. Intussusception not infrequently begins in the prolapse of the ileum through the ileo-cæcal valve, in the same way that prolapse of the rectum occurs through the sphincter ani. If death take place early, only a small portion of the ileum may have passed the valve. If the case be protracted, the tenesmus brings down more and more of the ileum, with its accompanying mesentery. The constriction of the valve, which acts as a ligature, soon prevents the further descent of the ileum; and, the tenesmus continuing, the next step in the displacement is the inversion of the caput coli, which is drawn into the colon by the descending mass, and, unless the case terminate by sloughing or death, the ascending and transverse portions of the colon are successively invaginated. The records show that intussusception occurs as above stated in a large proportion of cases. In one case, among those which I have collated, the invagination began a few inches above the valve, so that the ileum constituted a small portion of the exterior of the mass. Occasionally the cæcum is the part primarily inverted and invaginated, and, descending along the colon, it draws after it the ileum, which sustains its natural relation to the ileo-cæcal valve. When this occurs the cæcum is found at the lower end of the mass, and two orifices are observed, one leading through the valve, and the other into the appendix vermiformis. These two forms of invagi-

nation—that in which the ileum, passed through the ileo-cæcal valve, successively inverts and draws after it the caput coli and the divisions of the colon, and that in which the caput coli is primarily invaginated, and descending along the large intestine, inverts the latter, and draws after it the ileum—constitute the vast majority of cases of this disease in the first years of life.

I have notes of 45 fatal cases occurring under the age of twelve years, in which the portion of intestine first displaced is recorded. In 4 of these the displacement was entirely in the small intestine, involving in no way the colon; in 38 cases it commenced either by prolapse of the ileum through the ileo-cæcal valve, or by the inversion of the cæcum into the ascending colon, there being perhaps not much difference in the relative frequency of these two modes; in one case the invagination was confined to a segment of the transverse colon, in another to a segment of the descending colon, and in the remaining case to the lower part of the descending colon and the upper part of the rectum. In three instances the invaginated mass itself became invaginated, producing an intussusception of great thickness, and necessarily fatal.

Intussusception is sometimes attended by so little constriction of the incarcerated portion that it remains pervious. In such a case life may be protracted for weeks or even months, without reduction of the displacement or any material change in it, the passage of fecal matter being sufficiently free for the maintenance of life. Death finally occurs in a state of exhaustion. Thus in one instance a child, four months old, lived six weeks after the symptoms of invagination commenced, and seventeen days "with a portion of the bowel protruding from the anus." It was found at the post-mortem examination that part of the ileum had descended through the entire colon, and had remained pervious. In a case related by Dr. Worthington[1] symptoms of intussusception were present for seven months before death, and during the last six weeks of life the invaginated intestine protruded frequently from the anus, and was replaced by the mother. In this case "the cæcum was inverted, and descending through the colon to the lower portion of the rectum, carried with it the ileum and the entire colon, except the last ten or twelve inches." In another case the symptoms indicated a continuance of the disease for three, if not eight months. But such cases are exceptional. Ordinarily as the intestine becomes invaginated, its mesentery or mesocolon is also invaginated, and its veins compressed. The pathological state of the incarcerated mass soon becomes that of intense congestion. In infants, usually in a few hours, so great is the distention of the capillaries that they give way, blood escapes into the intestine, and passes from the bowels in scanty motions. On examining the invaginated intestine after death, if gangrene have not occurred, it is found of a uniformly intense red color, sometimes resembling to the naked eye a long and firm clot of blood. In those who die early no traces of inflammation are seen, but in more protracted cases the attrition between the serous surfaces excites local peritonitis. In none of the

[1] Amer. Jour. of Med. Sci. for January, 1849.

fifty-two cases which I have collated in which post-mortem examinations were made, did the inflammation extend more than a few lines beyond the invagination. Usually the intestine forming the exterior of the invaginated mass is much drawn together or puckered. In one case treated by myself, the entire large intestine which formed the exterior of the mass was compressed within a space of six inches or less, since about twelve inches of the ileum, doubled on itself, lay within the entire colon and protruded from the anus, the only part of the large intestine which was inverted being the caput coli. In one case six or seven inches of the ileum, which formed a portion of the exterior of the mass, were compressed within the space of one inch.

The abdomen, at first of natural fulness and soft, usually becomes more and more distended till the close of life; but in cases of much vomiting the distention is moderate. This fulness is due to gas and fecal accumulation above the invagination. The portion of the intestine below the displacement is ordinarily empty, except that in the infant it commonly contains mucus, mixed with more or less blood, which has escaped from the capillaries of the strangulated mass.

There are few anatomical changes in this disease, which do not arise directly from the intussusception, and are, therefore, located either within the mass or in its immediate vicinity. In those who recover by the process of sloughing, the cicatricial contraction may give rise to symptoms and lesions of greater or less gravity. Thus the late Sir James Y. Simpson examined a child aged 9 years, who recovered with loss of ten inches of intestine, and at the meeting of the Medical Society[1] before which the specimen was presented, remarked that there was unusual distention of the cutaneous veins of the patient, due probably to such compressions of the ascending vena cava by the cicatrix, that the venous circulation was obstructed. Mr. Charles King[2] relates the case of a child aged 6 years, who, on the eleventh day of the disease, voided the cæcum and a part of the colon. Two days subsequently pulsation ceased in the left leg, and all that part below the patella became gangrenous. The patient gradually recovered with loss of the leg. The cause of this unfortunate sequela was doubtless compression from the cicatricial contraction of the artery which supplied the leg, and probably the formation of a thrombus. Dr. F. Bush[3] relates a case in which he was enabled to observe the extent and appearance of the cicatrix. The patient, aged twelve years, discharged from the bowels fifteen to eighteen inches of the ileum on the eighth day of the intussusception, after which convalescence was rapid. Fourteen weeks later the child died from typhus fever, and at the autopsy "traces of the diseased bowels were visible by a contraction and puckering where the slough had taken place, and the parts united." But fortunately in most instances when the intestine sloughs and the child survives, no serious or permanent injury results from the cicatrization. The cicatrix stretches little by little, and accommodates itself to the surrounding parts.

[1] Trans. Medico-Chir. Soc., Edin.
[2] London Lancet for 1854.
[3] Lond. Med. and Phys. Journ. for December 18, 1823.

Symptoms.—The symptoms vary according to the age of the patient and the degree of strangulation. Pain in the abdomen, usually paroxysmal, is among the first, and is one of the most conspicuous symptoms. It is often severe, resembling the pain of hernia, and abating only with the failing strength of the child. After the first few days, if inflammation arise, the pain is continuous, though more severe in paroxysms. At first pressure upon the abdomen is tolerated, but afterward there is tenderness. This is due to the inflammation, which occurs in and around the invaginated mass, and it is, therefore, confined to the part of the abdomen in which the tumor lies. At this point also the abdomen is more full than elsewhere, and not infrequently the physician can feel the invaginated mass and detect its exact location, and approximately its extent. Sometimes, at an early period as well as late, cerebral symptoms occur, as in a case related by Dr. Coggswell,[1] which terminated in convulsions and death on the second day. Convulsions are, however, comparatively rare, and the mind is generally clear till the last moment. In infants the countenance, in the intervals of pain, in the first stages of the complaint, is often placid and not indicative of any serious disease, but in older patients constant and severe local symptoms, referable to the intussusception, commence early. At an advanced period, whatever the age, the countenance becomes anxious and haggard, the eyes hollow or sunken, the body loses its plumpness, and, if the case be protracted, becomes emaciated.

Vomiting is rarely absent; in thirty-nine out of forty-seven cases it is stated to have been present, in seven cases there is no record of this symptom, while it is recorded absent in only one case; but in this case, the records of which are very meagre, death occurred on the second day. The vomiting becomes stercoraceous in a few days, and it ordinarily continues with greater or less frequency till the period of collapse. It relieves partially the distention.

The appetite is impaired and often entirely lost. Infants at the breast commonly nurse, however, for several days, probably from thirst rather than hunger.

In most patients one natural evacuation occurs from the bowels after the intussusception commences, and then obstinate constipation succeeds. This evacuation consists of the excrementitious matter below the invagination. In children under the age of one year, scanty motions of blood mixed with mucus begin to occur in a few hours. In twenty-seven children under this age I find that twenty-four had such evacuations, occurring in most of them several times in the course of the day; in two of the twenty-seven there is no record of this symptom, but in the remaining case it is stated to have been absent. Scanty evacuations of blood unmixed with fecal matter have been considered pathognomonic of intussusception in the infant, and we see the ground for such belief, but in exceptional instances the invaginated mass is partly pervious, and although the dejections may contain blood, they are also excrementitious. In our collection of cases are three examples of this in infants under the age of one year. One has already been referred to. In this

[1] London Lancet for July, 1853.

case there was the rare anomaly of so large an opening through the ileo-cæcal valve as to allow not only prolapse and descent of the ileum through the entire colon, so as to protrude six inches from the anus, but also fecal passage through it daily.

In children above the age of one year, the capillaries of the invaginated intestine are not so frequently ruptured as under this age, and sanguineous evacuations are therefore less common. I have records of nineteen cases between the ages of one year and twelve, in only six of which it is stated that there were bloody motions, and in these the blood was not passed frequently, nor even in some cases daily, as in infants, nor in so pure a state, unless in two cases, the records of which are not explicit on this point. Two of these six patients passed moderate bloody evacuations after protracted periods of constipation, one had fecal discharges with the blood through the entire sickness, and in one blood was passed at first, but finally the stools were entirely fecal.

In those above the age of one year, obstinate constipation was ordinarily present, no dejections, either bloody or fecal, occurring for several days, but there were a few exceptions. In three cases the bowels were relaxed. The ileum, in these three, had descended through the entire colon, or the larger part of the colon, and being pervious, the feces escaped from the anus without detention in the large intestine, or with detention only in its lower portion, and were therefore liquid.

Tenesmus is another symptom. It is not always present, but in a large proportion of cases, even when the invagination is in the upper part of the large intestine, it is a frequent and distressing symptom. It often does not commence till there is a considerable amount of displacement, and it ceases when the strength is much reduced.

The temperature of the surface is normal in the commencement of intussusception; but finally, as febrile reaction comes on symptomatic of the inflammation, it rises and continues above the healthy standard till the intestine sloughs, or till the stage of collapse occurs which ushers in death. The pulse, especially in the infant, is tranquil at first, but, whatever the age, it soon becomes accelerated from the paroxysms of pain, and subsequently from the inflammation which occurs in the invaginated mass. There is no disturbance of respiration, except that it is somewhat hurried from the fever, and from the pain felt in advanced cases on full inspiration.

It will be seen that the symptoms vary in certain particulars, under the age of one year, from those occurring over that age, but differences in the symptoms depend more on the degree of invagination and constriction, that on the age and exact location of the disease.

Diagnosis.—The diagnosis of intussusception is not, in general, difficult, except at its commencement. When the inversion has reached that degree at which obstruction occurs, the symptoms are, in most cases, such that the disease can be readily diagnosticated. In the cases whose records I have collated a correct diagnosis was, with few exceptions, made, and at an early period. In the infant, the disease for which intussusception is most frequently mistaken is dysentery, on account of the tenesmus and the muco-sanguineous stools. In certain of

the reported cases this mistake was not rectified until it was ascertained that purgatives produced no fecal evacuations.

The symptoms which are commonly present, and which indicate the nature of the disease, are obstinate constipation, vomiting, paroxysmal pain referred to the seat of the disease, and tenesmus. In the infant, also, scanty evacuations from the bowels of mucus and blood, or of pure blood, are, as we have seen, an important diagnostic sign. It should be borne in mind, however, that in exceptional cases the displaced bowel may remain pervious, and the usual symptoms which possess diagnostic value therefore be absent. There may be no vomiting or tenesmus, and diarrhœa may even occur in place of constipation, as in the cases related above. As an aid to diagnosis, it should be stated that whatever the age of the child affected with intussusception, clysters are often administered with difficulty, and are quickly and forcibly returned, on account of the resistance opposed by the invaginated mass. We have stated above that the seat and even extent of displacement can be ascertained in a large proportion of cases by digital examination of the abdominal walls. The tumor can be felt hard, elongated, and tender on pressure, so that the diagnosis is clear. If the invagination have extended to the lower part of the large intestine, it can usually be discovered by an examination per rectum.

Duration.—In the following table, the duration of the intussusception in forty-nine cases is given, as nearly as it can be ascertained from the records:

2 died the 1st day.	1 died the 8th day.
6 " " 2d "	1 " " 10th "
14 " " 3d "	1 " " 14th "
2 " " 4th "	1 lived nearly a week, the exact time not being given.
5 " " 5th "	1 lived 6 weeks.
2 " " 6th "	3, time of death not given.
2 " " 7th "	7 recovered.
1 lived over a week.	

In two of the three cases in which the duration is not stated, the patient lived much longer than the usual period. One of these two, a girl of six years, having eaten raw carrots, was seized with pain in the abdomen, which lasted eight months, when she died. During the last three months she passed mucus and blood. In this case the cæcum had descended to the anus, drawing with it the ileum, which remained pervious. The symptoms indicated the continuance of the invagination for three months if not eight. The other patient was a boy, aged three years and four months, who complained of pain in the abdomen for many months, and occasionally vomited. During the last six weeks of his life, all the phenomena of invagination were present. In this case, also, the inverted caput coli had descended along the entire length of the colon, and at the autopsy it lay in the rectum.

In West's *Treatise on Diseases of Children* (fifth edition, 1866, page 504), it is stated that death in this complaint always occurs within a week. The above statistics, however, show that there are exceptions to this statement, although a large majority do die within the first seven days. In thirty-three of the cases embraced in my statistics death oc-

curred within the first week, and in no fatal case in which strangulation was complete was life prolonged beyond the eighth day. In these cases of complete strangulation the average duration was 3.7 days, and the largest number of deaths occurred on the third day. Death on the first day is rare, but it occurred in two of the cases embraced in my statistics. Death at so early a period usually takes place in convulsions and coma.

PROGNOSIS.—Intussusception is in its nature so grave an accident that the physician called to a case should always explain its gravity to the friends. But, while death is the common result, there are three different modes of termination in which life is preserved. First, the reduction of the incarcerated intestine, with immediate relief. There can be no doubt that it is possible for intussusception, when recent, to be reduced by the unaided action of the bowels, in the same way as the common, simple intussusception in the jejunum and ileum, or as hernia is reduced, through the vermicular action of the intestines, for sometimes, as in Dr. Coggswell's[1] case, the patients at some previous time have experienced the same symptoms as those which accompanied the attack, and which subsiding, they remained for a time in perfect health. This termination is probably rare, if the symptoms be sufficiently marked to necessitate treatment. Again, the intussusception may be cured by early and well-applied treatment. The physician often succeeds in reducing the displaced intestine, even if the intussusception be in the upper part of the colon, if he be called sufficiently early, and employ the proper measures.

A second mode of favorable termination is alluded to by certain foreign writers. The intussusception continues for a considerable period with the characteristic symptoms, and then, as Bouchut expresses it, "the vomitings gradually cease, the intestinal hemorrhage disappears, the strength returns, and the health becomes restored without the expulsion of fragments of the intestine." What changes the displaced intestine undergoes in these protracted cases, which gradually recover without sloughing, have not been clearly ascertained, although they have been the subject of conjecture. According to Rilliet, a large proportion of favorable cases terminate in this manner. It does not appear, however, from the statistics which I have collected, that this is a common mode of recovery. The clinical history of intussusception establishes the fact that in a large majority of protracted cases there is either death or the third mode of favorable termination, namely, by sloughing.

But we cannot reasonably expect recovery in young children through sloughing and the expulsion of the intestine; since few have the requisite strength for so tedious and exhaustive a process. The youngest child that recovered in this way, so far as I have been able to ascertain, was an infant thirteen months old, whose case was reported by M. Marage. With the exception of this case, the youngest was a boy, aged five years. The older the child, the greater, of course, the power of endurance, and the better the prospect of recovery. Of the fifty-two cases whose records I have collated, seven recovered by the sloughing

[1] London Lancet, July, 1853.

and expulsion of the mass. These children were of the ages of five, six, six, nine, eleven, twelve, and twelve years. The separation of the invaginated mass occurred in six of these between the sixth and twelfth days, with an average of nine and a half days. In the remaining case the time is not given. If, then, the patient can be carried through the first week without too much exhaustion, we may each day look for the discharge of the slough, the reopening of the bowels, and ultimate recovery.

But in those cases in which the intussusception remains open, so as to allow the passage of fecal matter, recovery is improbable unless the displacement be diagnosticated early and properly treated. If the intussusception continue, it becomes greater and greater from the absence of strangulation. Without inflammation and with little or no congestion of the displaced portion, and without the severe symptoms which occur in ordinary cases, the patient wastes away, having irregular evacuations and more or less abdominal pain, and finally dies in a state of emaciation and weakness. In the early stage of this form of displacement it is not improbable that injections or inflation, employed with sufficient force, will give relief, but if the early period pass without such treatment, cure is impossible by the ordinary methods. It is in such instances especially, to wit, those in which the displacement occurs without strangulation or inflammation, and in which fecal matter passes through the displaced mass more or less freely, that laparotomy is justifiable, and is likely to give relief, when injections and inflation have been employed in vain. Jonathan Hutchinson's successful performance of this operation in a child of two years, who had this kind of displacement, is known to most readers.[1]

The prognosis is most favorable when the displacement occurs in the lower part of the large intestine, for its reduction is then comparatively easy. An interesting case of this kind was observed and treated by Drs. O'Dwyer, Reid, and myself, in the New York Foundling Asylum, in 1875. The child was a female, aged two years, and had had previous good health. The invaginated mass protruded like a prolapse, about four inches outside of the anus. It was cold, considerable hemorrhage had occurred from it, and the infant seemed in collapse. When the mass was returned so far as it could be carried within the pelvis, by the index finger, the lower end of it could still be felt like an os uteri. It protruded four or five times within twenty-four hours, but, by replacement so far as possible with the fingers, and the use of simple water injections, with the hips elevated, it was finally permanently reduced, and, with the use of stimulants, she soon fully recovered.

Mode of Death.—This is different in different cases. It sometimes occurs from collapse. At a meeting of the New York Pathological Society, held December 10, 1873, I presented a specimen, showing intussusception occurring about one foot above the ileo-cæcal valve, in an infant aged thirteen months. On the day before its death, its previous health having been good, it seemed ill, and vomited once or twice, but did not appear to be in pain. It had two evacuations from

[1] London Lancet, November 22, 1873.

the bowels, of the usual appearance, in the latter part of the day. On the following morning it was unexpectedly in collapse, and died within about twenty-four hours from the commencement of the sickness. At the post-mortem examination the cranium was not opened, but all the organs of the trunk were found normal except the intussusception. The mass involved in the displacement measured two and a half inches in length, and was slightly crescentic. The mucous membrane above and below it had the normal appearance, as did that of the external or incarcerating portion of the mass, while that of the incarcerated part was deeply injected. Water poured into the intestine above the invagination was wholly arrested by it.[1] But in the majority of instances death occurs from asthenia, which comes on gradually, but increases rapidly in consequence of the pain, vomiting, and imperfect nutrition. Children dying in this way may have convulsive movements more or less marked, but the prevailing characteristic as death approaches is extreme exhaustion. In exceptional instances the life of the sufferer is cut short by convulsions before the stage of exhaustion is reached. Thus a child aged three years, whose case was reported by Dr. Isaac Thomas,[2] and another, aged two years, whose case was reported by Dr. Coggswell,[3] died in convulsions on the second day.

TREATMENT.—It is unfortunate, in cases of intussusception, that the time in which treatment can be of most service is likely to pass by before the true condition of the intestine is detected. Invagination being comparatively rare, the patient is generally on the first day treated for colic or dysentery or some other common affection of the bowels; and it is often not till the second day, when the intestine has become incarcerated, that the physician accurately diagnosticates the disease. The purgative medicines often given in the commencement injure the patient. In fact, both reason and experience teach us the impropriety of using purgatives in this complaint. Cathartic remedies act as a *vis à tergo*, and may cause still further descent of the inverted intestine. Yet such powerful agents of this class as quicksilver have been employed. It was administered in two doses of one ounce each in one of the cases embraced in my statistics, but none of the mineral passed the bowels. At the post-mortem examination a considerable part of it was found in small globules, coated with a black layer consisting of the sulphuret or black oxide of mercury, in the intestine above the intussusception. It need not be added that the case was speedily fatal.

The proper treatment of intussusception consists in attempts to reduce the displacement by pressure from below. The pressure may be applied either by liquid injections into the rectum or by inflation of the lower intestine by air or gas.

Injections should be made with lukewarm water, for cold or hot water may cause contraction of the muscular fibres of the intestine, and increase the constriction. The child should be placed in bed, or in the nurse's lap, with the nates elevated 45°. With the common India-rubber, or

[1] New York Medical Record, April 1, 1874.
[2] Amer. Med. Recorder, 1823.
[3] London Lancet, July, 1853.

better the fountain-syringe, and the aid of an assistant, the liquid should be gently thrown into the rectum until the abdomen is somewhat distended. By carrying the fingers, firmly but gently applied upon the abdominal walls, along the direction of the colon, the liquid is made to press against the lower end of the intussusception. The same gentleness and perseverance are required in kneading and pressing the abdominal walls as in the treatment of hernia, by taxis. If the invagination be in the descending colon, probably only a small quantity of the liquid can be injected, and it may be forcibly returned, but by repeating the injections a sufficient quantity can ordinarily be introduced to obtain the full effect of the mode of treatment. There is also sometimes an increased irritability of the rectum, even when the intussusception is at the upper extremity of the large intestine, so that tenesmus and expulsive efforts follow the introduction of the instrument. The assistant can aid in overcoming this by pressing the soft parts of the nates around the instrument.

If the injection fail to reduce the displacement, it may be repeated after allowing the patient to rest for a while. In the *New York Medical Journal* for May, 1875, is the history of an interesting case, which was treated by Drs. Church and Warren of this city, and is reported by the latter. The infant was seven months old and had the usual symptoms such as frequent paroxysmal pain in the abdomen, vomiting, tenesmus, scanty muco-sanguineous stools. On the third day injections were twice employed without result, but on the fourth day an injection of ten or twelve ounces reduced the displacement, and the infant recovered. In a second case treated by Dr Warren the age was nine months, and a tumor appeared a little above the umbilicus a few hours after the commencement of the symptoms. The following is Dr. Warren's account of this interesting case, which will give a clear idea of the proper mode of treatment:

"The patient was looking very pale and prostrated, the pulse was quick and feeble, and the skin cold. I at once determined to use fluid injections, and, with the little patient placed in a semiprone position in his mother's lap, with an ordinary Davidson's syringe I commenced injecting tepid soap and water, but after perhaps a gill had been thrown into the rectum, it was almost immediately rejected, very highly colored with blood, and mixed with it a very small quantity of mucus and fecal matter; the latter, by the way, not hardened, but of the consistency of soft putty. In a second attempt the fluid was retained longer, but was after a little while discharged, with more blood and mucus, but with much less tenesmus and pain.

"When, soon after, I made my third attempt, the child's chest was rested upon the side of its mother's lap, with the lower extremities elevated by an assistant, so that the position was at an angle of about 45°, anus upward. This time I injected the fluid very slowly, in order to avoid, if possible, the irritation caused generally by the frequent emptying and refilling of the syringe (which, by the way, is a very serious hindrance to the successful use of this syringe, and which renders it much inferior to the fountain or hydrostatic). In this manner I succeeded in injecting, as I estimated at the time, perhaps ten or twelve

ounces, and during the operation the child gradually became more quiet, and had, when I ceased, fallen asleep. Then, with the direction that occasional doses of tinct. opii camph. should be administered during the night, to control, if possible, the peristaltic action of the intestines, I left him.

"On the following morning, to my surprise, I found the child sleeping quietly and naturally, and I was informed that at about 5 A. M. (six hours after my visit) he had a movement of the bowels, which was saved for my inspection, and consisted simply of the enema, slightly colored with fecal matter. From that time he seemed to be entirely free from pain, and six or seven hours later had a natural passage, after which recovery progressed rapidly, and in a few days he was discharged well."

The following case is interesting as showing success from the use of injections after the lapse of two days, in a severe case, which had resisted treatment on the first day. The good result was apparently in great part due to the manipulation which was made so as to press the water against the course which intussusceptions are known to take.

On September 10, 1876, I visited, with Dr. Gillette, a nursing infant, aged nine months, whose history was as follows: It was habitually constipated, but it continued in its usual health till September 8, on which day it was carried by its nurse to one of the city parks. After its return it began to be fretful; it vomited, and seemed to be in pain. It continued to vomit frequently, especially after nursing, or taking drinks, and in the ensuing night passed two scanty stools of mucus and blood without fecal matter. In the morning of September 9th, Dr. G. was summoned, who found the pulse 180, and temperature 102°, and the matter vomited greenish like bile. In the evening the temperature was $102\frac{3}{4}°$. Dr. G. diagnosticated intussusception, and employed injections of water, but they were returned without bringing fecal matter, and without apparent result. He also administered opiates by the mouth.

September 10th, temperature $102\frac{3}{4}°$; features pallid, beginning to have a pinched or sunken appearance, and indicative of much suffering; no nutriment is apparently retained on account of the frequent vomiting, and the bowels are obstinately constipated. As the symptoms indicated rapid sinking and collapse, consultation was called at 4 P. M. It was impossible to determine certainly, through the abdominal walls, on account of the distention, whether there was any tumor, but it was my opinion, and the opinion of one of the other physicians, that a tumor, hard and inelastic, could be felt nearly in the median line, between the umbilicus and the symphysis pubis. At about 5 P. M. the shoulders of the little patient were lowered, and the nates elevated, so that the trunk formed an angle of perhaps forty-five degrees with the horizontal, and a large quantity of tepid water was gently passed into the intestine through Davidson's syringe, with the vaginal nozzle attached. It was impossible to estimate the quantity retained, since a considerable part of it escaped, although the anus was firmly pressed around the instrument.

When the abdomen was distended as fully as seemed justifiable, the nates being still elevated, and the liquid retained, so far as possible, by firm pressure upon the anus, the abdomen was firmly and deeply kneaded by the hand, the movements being made chiefly from the right lumbar

toward the right inguinal, and from the right inguinal toward the hypogastric region. The kneading was continued perhaps eight or ten minutes, and the water, which contained no perceptible amount of fecal matter, blood, or mucus, was allowed to escape.

After this operation the child became quiet, slept, and the vomiting ceased. At our next visit at 7 P.M., although the severe symptoms had in great part abated, and the countenance had lost that pinched and suffering aspect which was so prominent before, it was deemed best, in consultation, to repeat the injection, and this time through a rectal tube, which was introduced further than the nozzle employed at the preceding visit. The body was placed in the same position as before, and the abdomen kneaded in the same manner. The water, when allowed to return, brought no fecal matter, but the last that flowed contained two shreds, the largest about one inch in length by two lines in width, resembling matted and nucleated epithelial cells. It was believed that they were composed of such cells, with perhaps some of the mucous membrane to which they were attached, and that they were detached from the invaginated portion. An opiate mixture was now prescribed, to be given sufficiently often to relieve any restlessness, and keep the patient quiet, and a flaxseed poultice was applied over the abdomen. On the following day the temperature was 103½°, pulse 158, and the abdomen somewhat distended; but the vomiting had ceased, and there had been two fecal evacuations since our last visit. The intussusception had been relieved, the inflammatory symptoms soon abated, and the infant's health was fully restored.

Injections in order to be effectual, and give promise of success, must be aided by gravitation. Unless the nates be so elevated as to obtain the benefit of this hydraulic principle, I am convinced that inflation is more likely to reduce the displacement, and if, after sufficient trial of injections, relief be not obtained inflation should be employed. Inflation produces an equable and effective distention of the external or incarcerating portion of intestine, and cases of cure by inflation have been reported after injections had failed. Treatment by inflation, which indeed ought to occur to any intelligent physician appreciating the anatomical condition of the parts, as the correct mode, was prominently brought to the notice of the profession in modern times by Mr. Samuel Mitchell.[1]

"I take the liberty," he writes, "of suggesting to the profession, through the medium of your valuable periodical, the trial of inflating the bowels by means of a glyster-pipe attached to a common pair of bellows; it has fallen to my lot to witness several of these most distressing cases in children; the nature of the obstruction was foretold during life, and unfortunately verified by post-mortem examination. The last case of the kind which came under my care, about two years since, presented all the usual symptoms: intolerable restlessness, the most obstinate sickness, the singularly distressed state of countenance, and shrunken features. The usual remedies were had recourse to, viz., warm baths, glysters, anodyne frictions over the abdomen, etc., but without

[1] London Lancet for March 17, 1838.

avail. As a forlorn hope, I made trial of inflation by the above means, with the most happy result. The sickness immediately ceased; the child within an hour passed a natural stool, and in the morning was almost without ailment."

This mode of treatment is termed novel in the *Lancet*, but it is really as old as the time of Hippocrates, who speaks of throwing air into the bowels, by which flatulence is imitated (flatus immitatur).[1] Haller[2] also recommended the same treatment: "Flatus etiam immissus celerrime susceptionem dispellet." Dr. David Greig[3] relates five cases of successful treatment of intussusception by inflation. The first, an infant six months old, previously in good health, suddenly became very fretful, apparently having severe paroxysmal pain in the abdomen. She had vomiting, and finally tenesmus, with bloody evacuations. Warm water enemata could not be employed on account, the writer thinks, of the spasmodic action of the intestines, and an abdominal tumor could be felt near the umbilicus. Castor oil and a purgative powder, and enemata of water having been employed in vain, and the case becoming really critical on the second day, inflation was resorted to. The writer says: "The nozzle of a small pair of bellows was introduced into the anus, and air injected to a considerable extent. Contrary to our expectation, the air passed readily into the bowel, and seemed to give the child great relief. After the injection it lay very quiet, as if asleep, and evidently quite free from pain. In about twenty minutes from the time the air injection was administered, a slight rumbling noise was heard in the child's abdomen, followed by a crack so loud and distinct as to alarm the attendants in the room, who thought something had burst in the child's bowels. The child, however, continued as if asleep, and free from pain, and in about half an hour a large feculent stool, slightly mixed with blood and mucus, was passed without pain. During the night the child rested pretty well, had no return of vomiting, took the breast as usual, and in two days was quite well.

Another child, nine months old, treated by Dr. Greig, presenting nearly the same symptoms and the abdominal tumor, also obtained relief by inflation, after castor oil and enemata had failed to produce any benefit.

An apparatus for the production and injection of carbonic acid gas has been invented by Schultz and Warker, of this city, and is manufactured by them. It consists essentially of two glass chambers, one over the other. In the lower one a bicarbonate is placed, and in the upper an acid in a liquid state. By the gradual admixture of the two, carbonic acid is set free. An elastic tube conveys the gas from the lower chamber. The apparatus has been used by physicians of this city for the reduction of intussusception and other purposes, and is a useful invention.

The same firm, and several others in this city, prepare for the shops large bottles of highly charged carbonic acid water, from which when

[1] Hippocrates's Works, translated from the Greek by Grimm, 4 bd., page 198.
[2] Physiologia Corporis Humani, tom. vii. p. 95.
[3] Edinburgh Medical Journal, October, 1864.

inverted a powerful current of carbonic acid gas can be obtained. Two or three of these bottles, with a portion of the tube from Davidson's syringe, which can be readily attached to the stem from which the gas escapes, constitute all that is required for an ordinary case.

The following cases, which I treated with Dr. Büchler, of this city, in 1871, show what may be achieved by inflation, and also the unfavorable result which must inevitably occur in certain cases. A German infant, five months old, nursing, began to be fretful, crying often, on March 7, and before night passed a scanty motion of blood. The symptoms continuing, I was asked to examine the infant on the 10th, and learned the following facts: It had vomited daily, had had daily scanty but infrequent stools, consisting chiefly of blood, accompanied at first by tenesmus, but not within the last day; it continued to nurse, but was becoming thinner and weaker, and was evidently in pain. The symptoms indicating the nature of the disease, the abdomen, which was not distended, was examined for the tumor, which was found in the right side in the site of the ascending colon, apparently about one and a half to two inches in length; pulse 124 in sleep; no cough. An ineffectual attempt was made to reduce the intussusception by a very rude and imperfectly constructed apparatus (the bellows), when from the lateness of the hour further treatment was postponed till early the following morning. 11th. Tumor still detected in the right lumbar region; pulse 120 asleep, 150 awake. By means of Schultz and Warker's apparatus, the intestines were inflated so as to produce very decided prominence of the abdomen, and the abdomen gently kneaded. After some minutes the gas was allowed to escape, when the tumor had disappeared. In a few hours, a natural evacuation occurred from the bowels, and the infant has remained well since.

The second case ended unfavorably, although the symptoms were apparently no more grave than in the case just related, and had continued a shorter time. This infant was also of German parentage. The tumor, firm and elongated, could be distinctly felt in the left lumbar region. In this case the inverted bottles of carbonic acid water were employed, and when, after considerable delay and kneading of the abdomen, the gas was allowed to escape from the intestine, the tumor had disappeared. A few hours afterward convulsions occurred, ending fatally. At the autopsy the invaginated mass, which was too firmly strangulated to admit of reduction by inflation, was found in the epigastric region, having been carried up from its former position by the inflation of the intestine below. It consisted of the terminal part of the ileum, which had passed through the ileo-cæcal orifice, and had become incarcerated in the ascending colon, and, as is not unusual in these cases, the action of the intestines had changed the location of the tumor in the abdomen from the right to the left side.

Whether air or carbonic acid be employed, it is necessary to produce distention of the intestine to its fullest extent below the seat of the complaint, without endangering rupture, and of course the sooner it is used the better the chance of success. In a few days the displaced intestine has, in a large proportion of cases, become so firmly incarcerated, and has descended so far, that attempts to replace it, either by

injections or inflation, are unsuccessful; still, even at a later period, a persevering attempt should be made if it have not previously been tried. If injections and inflation fail to effect the desired result, the employment of quicksilver, by the rectum with the thighs elevated, has been suggested to me as worthy of trial by a physician of large practice in this city, who has had considerable experience with intussusceptions. This may be a useful suggestion, especially if the invagination be in the descending colon.

If the modes of treatment which I have recommended above fail to give relief when perseveringly and sufficiently employed in a case of acute intussusception, the patient's state is one of extreme peril, and the prognosis is unfavorable. Yet recovery is possible in one of two ways, namely, by incision through the abdominal walls (laparotomy), and reduction of the displacement by the fingers within the abdominal cavity; and secondly, by sloughing of the invaginated mass, and union by adhesive inflammation of the ends of the intestine which have preserved their vitality. Atrophy of the imprisoned part so seldom occurs in a case which has resisted injections and inflation, that it need not be considered, in this connection, as a mode of recovery.

Laparotomy has been successfully performed in a child aged two years, as I have stated above, by Dr. Jonathan Hutchinson, of London. The case was one of those exceptional ones in which great displacement had occurred without strangulation. It had continued as indicated by the symptoms about one month, and a portion of the intestine terminating in the ileo-cæcal valve had protruded several inches from the anus. "The patient was anæsthetized by chloroform, and the abdomen was opened in the middle line below the umbilicus. The intussusception was then easily found, and as easily reduced. The after-treatment consisted only in the administration of a few mild opiates, and the child made a rapid recovery."[1] In a case of this kind, there can be no doubt of the propriety and necessity of laparotomy as a last resort, for there being no strangulation, sloughing could not occur, and death sooner or later, from exhaustion, must be the result. Cases of this sort have usually been left to perish, after the ordinary modes of relief have failed. Thus as far back as 1784, M. Robin published[2] the case of a child aged $3\frac{1}{2}$ years, who died after the lapse of three months, with a cæcum protruding from the anus; and in the *Amer. Journ. of Med. Sci.* for 1849, Dr. Worthington published a similar case, in which a child aged three years and four months lived a longer time. In these days of anæsthetics, and with the brilliant success of Hutchinson, a physician would, in my opinion, be reprehensible if he allowed a child aged two years or over, with this form of displacement, to perish without strongly advising laparotomy.

But the question arises, whether in those more frequent cases of intussusception in young children in which, after the displacement has continued a few hours, there is such firm constriction of the invaginated mass that the patient suffers much pain and constitutional disturbance,

[1] London Lancet, November 22, 1873.
[2] Mém. de l'Acad. de Chirurg.

and probably passes bloody stools, and injections and inflation have failed to reduce the displacement, laparotomy is justifiable. This operation, in the case of infants, has heretofore been regarded as so dangerous, and so likely in itself to prove fatal, that the profession have generally considered it unjustifiable, believing that, although death was nearly certain without it, the performance of it did not increase the chances of a favorable result. Dr. J. B. Sands, of New York, has recently shown that laparotomy is justifiable, as a last resort, for the relief of this form of intussusception, even in the youngest infants; and in the following case, recorded in the *New York Medical Journal*, June, 1877, saved the patient, who doubtless would otherwise have perished.

On March 11, 1877, an infant of six months suddenly presented the characteristic symptoms of intussusception, such as tenesmus, abdominal pain, vomiting, and bloody stools. A few hours later, when Dr. Sands was called, the pulse was rapid and feeble, with symptoms of collapse. An elongated tumor could be felt in the abdomen, extending from the left iliac region to the left hypochondrium, inelastic, tender on pressure, and dull on percussion. The lower end of the invaginated mass could be readily touched by the finger introduced into the rectum. The usual methods to effect reduction were at once employed with partial success, for the tumor disappeared from the site where it had been discovered, and was reduced to a small and firm mass, on a level with the umbilicus, but it resisted any further attempts to effect its reduction.

Dr. Sands then, having etherized the patient, made an incision in the median line of the abdomen, extending downward about two inches from a point a little below the umbilicus. Through this opening, proceeding cautiously, and using as little violence as possible, he was able, after some delay, to reduce the displacement. The invaginated mass, which was only one and a half inches in length, consisted of the terminal portion of the ileum and cæcum, which had entered the ascending colon. The wound was closed by five silver sutures, which embraced the peritoneum, and the patient made a good recovery. The operation was performed eighteen hours after the commencement of symptoms.

Dr. Sands has collected the statistics of twenty cases of laparotomy for intussusception occurring at different ages, in which the result was stated Of these, seven recovered, or one in three; but he judiciously remarks, considering the gravity of the operation, that it is doubtful whether future statistics will show so favorable a result of laparotomy for this displacement as to justify the frequent use of the knife. For facts and statistics relating to this subject the reader is referred to an able and elaborate paper by Dr. Ashhurst.[1]

It is obvious that the earlier the displacement is recognized, the greater the probability of the reduction by the judicious use of injections and inflation, and it is seen from cases related above that this treatment may be successful as late as the second or third day, after previous attempts to reduce the intussusception by the same means have failed, and when there is that degree of strangulation that bloody stools occur. But,

[1] American Journal of the Medical Sciences for July, 1874.

as my own experience has shown me, there is also inevitably a large proportion of cases in which the use of injections and inflation, however judiciously and perseveringly made, totally fail, and it seems to me, in the light of present experience, that when pressure from below by water, air, or gas, which is the only efficient mode of treatment short of the knife, has been tried sufficiently long and often without result, that it is the duty of the physician to seek surgical advice in reference to laparotomy, as he would in a case of hernia, especially since, under Lister's antiseptic method, the danger from severe operations appears to be considerably diminished. It may be added that laparotomy performed on the first or second day will be much more likely to save life in ordinary cases than if performed later, since the strangulated intestine is soon badly damaged, and a local peritonitis is likely to be developed any time after the first forty-eight hours.

When an intussusception has reached that stage in which active interference is no longer proper, the physician can only prescribe opiates, with sustaining measures and an emollient poultice over the abdomen, and must await the result. The diet should consist of beef juice and other concentrated nutriment, which leaves little residuum. Vomiting, which is so common, is best controlled by bismuth and opiates; convulsions require the bromide of potassium, and an enema of three to five grains of chloral hydrate, dissolved in a little water.

SECTION IV.

DISEASES OF THE GENITO-URINARY ORGANS.

Uric Acid Infarctions.

Infarctions of uric acid or the urates are very common in newborn infants. They are seen, if an opportunity of examining the kidneys occurs, as yellowish-red lines in the tubules of the kidney, or lying in the pelvis, forming small yellowish granules. As they are washed away by the urine, we often find them upon the diaper. The irritation produced by these infarctions sometimes causes painful micturition. Children a few months old, often fret or cry from pain during urination, in consequence of the irritating action of the uric acid, while in the intervals between the passing of water they may or may not be free from suffering. Perhaps they pass only a few drops of urine with straining, and in it we find crystals of uric acid or the urates. Urine highly acid from the presence of this substance, causes a burning pain in the urethra, and sometimes redness not only of the urethra, but even of the labia over which the urine flows. Although infants, perhaps, suffer most from this cause, the same condition not infrequently occurs in older children. Their urine previously normal, becomes unduly acid from some error in feeding or in the digestive process, and uric acid crystals or concretions form. An exaggerated secretion of mucus occurs from the surface of the bladder or from the urinary canal, in consequence of the irritation produced by the acid, and sometimes pus-cells are also seen under the microscope mixed with the mucus.

The state of the urine described above should be at once rectified, for it furnishes the conditions in which calculi form either in the pelvis of the kidney, or in the bladder. Urine unduly acid and irritating, probably at first causes catarrh of the delicate membrane lining the tubules and pelvis of the kidneys, and if the irritation be sufficiently severe, the catarrh extends along the ureters to the bladder, causing a degree of cystitis. Now a catarrh of the pelvis of the kidney or the bladder, greatly increases the tendency to the formation of calculi, since the crystals become imbedded in the mucus which serves to agglutinate them. Uric acid when so abundant in the urine as to cause symptoms, should be at once treated, and the acid neutralized by an alkali. The liquor potassæ, employed as recommended in our remarks on the treatment of enuresis, is the best alkali for this purpose. For an infant of one year, two drops sufficiently diluted in mucilage will be sufficient, repeated in three or four hours.

Enuresis.

Enuresis, or incontinence of urine, is a common and troublesome infirmity in children. It occurs both in boys and girls, but is more common in the former than in the latter. In many children it dates back to infancy; but others have a respite from it in the years immediately succeeding infancy, until the sixth or seventh year, when it returns. It may be diurnal as well as nocturnal, interfering seriously with the comfort of the child, and rendering his schooling inconvenient; but the annoyance which it causes is commonly most at night, and it is for nocturnal enuresis that the physician is most frequently consulted. The child may pass his urine in bed every night, or even more than once each night, or there may be occasional nights of immunity.

The bladder consists of three concentric coats. 1. On the outside, the peritoneal, which covers the posterior, the superior part of the lateral, and the anterior aspects of the organ. 2. The muscular, which chiefly concerns us at present, and which consists of two layers—the one external, the fibres of which have a general longitudinal direction; the other internal, whose fibres are circular. The circular fibres become more abundant, producing greater thickness of this layer at the urethral orifice, and they extend a distance over the urethra. This increase in the number of circular muscular fibres at the urethral orifice constitutes the sphincter vesicæ. The fibres in the muscular coat of the bladder are unstriped, and are not under the control of the will.

A second sphincter, which aids materially in the retention of urine, is formed by the compressor urethræ. This muscle, arising by aponeurotic fibres from the ramus of the pubes, surrounds the whole membranous portion of the urethra, extending from the prostate to the bulbous portion. The compressor urethræ is a striped muscle, and its action is therefore controlled by the will. Certain accessory muscles influence the retention as well as the expulsion of urine, to wit, the levator ani, acceleratores urinæ, and the abdominal muscles,

Nerves.—The muscular coat of the bladder receives its nerves from the hypogastric plexus, which belong to the sympathetic system, although filaments enter the plexus from the spinal system. The innervation of the bladder is, therefore, twofold—that derived from the sympathetic system predominating over that from the spinal system, as shown by the relative number of filaments from the two sources. According to Belfield, the spinal centre of the motor nerves of the bladder is in the vicinity of the third lumbar vertebra; but Budge, in his experiments on rabbits, locates it in this animal in the vicinity of the fourth lumbar vertebra. The spinal centre of the nervous supply of the bladder, says Coulton, "is connected with the brain by a strand of fibres, which may be traced from the cerebral peduncle along the anterior columns of the spinal cord." The neck of the bladder, including the sphincter vesicæ, derives nervous fibres directly from the anterior or motor roots of the third, fourth, and fifth sacral nerves; and it is more abundantly supplied with nervous filaments than is the muscular coat of the organ. That the sphincter vesicæ is under the control of the will, is, therefore, apparent

from the anatomical characters, since a strand of fibres connects the peduncles with the motor centre of the bladder in the spine, and this centre connects with the sphincter through the spinal nerves. In normal urination, the sphincter is relaxed by the volition of the individual, while the muscular coat of the organ, being under the control of the sympathetic system, and involuntary in its action, expels the urine as soon as the sphincter is open.

The pudic nerve also sustains an important relation to the function of the bladder. Arising from the sacral plexus, it is distributed "to the base of the bladder, the prostate, the integument of the penis, scrotum, and perineum, the urethral muscles and mucous membrane, and the sphincter of the anus; in the female, the uterus, vagina, and vulva, are supplied by branches of the same nerve." Knowledge of the distribution of the pudic nerve enables us to understand the manner in which disease or abnormal conditions of the genital organs and anus disturb the functions of the bladder. Irritation of the inferior branches of this nerve affects the action of the superior branches, or those which supply the base of the bladder and the urethral muscles, so as to produce in certain patients dysuria, or incontinence, or both.

Etiology.—In all cases the urine should be examined, since the cause of the enuresis is often discovered in the deviations in it from the normal state which are apparent on inspection. The chief causes may be grouped as follows, but often two or more of them are present in the same case:

1. Too great acidity of the urine. The urine, in its normal state, is acid from the presence of the acid phosphate of sodium (Robin), but in certain conditions the acidity becomes so great that the urine is unduly stimulating to the surface of the bladder. Now, stimulating or irritating urine causes the bladder to contract, just as an irritating substance in the intestines increases the peristaltic and vermicular movements of this tube. Excessive acidity of the urine is commonly due to the presence of uric acid, resulting from decomposition of the urates; but in certain conditions lactic and hippuric acids, resulting from faulty digestion, appear in the urine (Robin); urine unduly acid renders its retention difficult, except in moderate quantity, so that enuresis results.

2. Increased quantity of urine. This sometimes occurs from the free use of liquids, as of water or of milk. Renal disease, attended by an exaggerated excretion of urine, sometimes produces enuresis. Henoch[1] says: "I would advise you never to omit an examination of the urine, because cases of diabetes mellitus and chronic nephritis are known, which were first manifested by nocturnal incontinence."

3. A vesical calculus. This is an infrequent cause, but when present it is likely to produce both diurnal and nocturnal enuresis. If micturition be frequent and painful by day and by night, if the urine contain a large amount of mucus or muco-pus, so as to render it turbid, and if the dysuria and frequent urination be not soon relieved by treatment, a calculus is probably present. In such cases the bladder should, of course, be sounded by the proper instrument to render diagnosis certain.

[1] Diseases of Children, page 257.

4. The muscular coat of the bladder may have an exaggerated contractile power in itself, and not imparted to it by any extraneous stimulating agency. The surrounding conditions may be normal, while the bladder is hypersensitive, so as to contract with undue energy by ordinary stimulation. The fault is in the bladder itself, whose functional activity is in excess; this appears to be the most common cause of enuresis in children. It is the condition of the bladder which Trousseau had in mind when he wrote: "I repeat that the nocturnal incontinence of urine is a neurosis, and I now add that it is a neurosis manifesting itself by excessive irritability of the bladder; in fact, the immediate cause of incontinence is this excess of irritability in the muscular fibres of the bladder." As Bretonneau pointed out, children with enuresis from this cause, habitually pass urine in a full and rapid stream, and, therefore, in less time than other children, showing that the contractile power of the muscular coat is in excess. From the fact that belladonna relieves so many patients, we infer that irritability of the muscular coat is a common cause of enuresis in children, since this agent acts by diminishing muscular contractility.

5. Weakness of the muscular fibres which constitute the sphincter of the bladder. Diminished tonicity of the sphincter muscles does not occur, or it occurs very rarely in those who have had previous good health, and are robust. Ordinarily, children affected by enuresis from this cause are in habitual ill health. They have had long and prostrating sickness, which has diminished muscular tonicity, or they have local disease in the spine, or in the course of the spinal nerves, which has impaired the innervation of the sphincter. Sometimes incontinence of feces is also present, and examination of the sphincter ani, by introducing the finger, shows that its contractile power is insufficient. We infer the presence of atony of the sphincter vesicæ from the atony thus easily discovered of the sphincter ani. As an example of enuresis from atony of the sphincter vesicæ, we may mention the case of a boy of thirteen years, who had "a flat doughy tumor" at the lower end of the dorsal vertebræ, in the middle of which a deficiency in the bony arch which covers the spinal cord, was detected by the fingers, showing that the tumor was a spina bifida, containing a considerable amount of adipose and granulation tissue. The congenital deficiency in the spinal column, and consequent injury of the spinal cord, had produced incontinence of both urine and feces.

6. We have already, in speaking of the distribution of the pudic nerve, alluded to the fact that enuresis in children is not infrequently produced through reflex action by disease or an abnormal condition external to the bladder, in parts which receive their nerves from the same source as the bladder. Henoch says: "Occasionally congenital phimosis, stricture of the urethra, irritation of ascarides, fissure of the anus, onanism, or vulvitis can be detected, upon the removal of which the enuresis ceases." Trousseau relates the case of a young man of seventeen years, who from childhood had been in the habit of wetting his bed two or three times every night. After unsuccessful trial of belladonna, strychnia, and mastich, it occurred to Trousseau that the infirmity might be due to congenital phimosis, and accordingly Pro-

fessor Jobert circumcised him. With the exception of three consecutive nights, he was entirely relieved of his enuresis during his subsequent stay of nine months in the hospital. In dispensary practice, in New York City, we find preputial adhesions, with the accumulation of smegma between the glans and foreskin, and more or less balanitis, a common cause of disturbed function of the bladder. The dysuria and enuresis cease when the adhesions are divided by the probe, the smegma removed, and the preputial inflammation or irritation has abated.

7. A psychical cause, to which Bartholow alludes. The patient dreams that he is in a convenient place for urination, the desire of which is impressed on his thoughts, and awakens to find that he has urinated in bed. Since the action of the bladder is largely under the control of the will, a strong will or determination—if the patient be not too sound a sleeper, does exercise a controlling action over the bladder, even during sleep. We sometimes observe this effect of will power in the fact that the patient breaks the habit of enuresis through a sense of shame, or by a determination to avoid the disgrace. Thus one writer mentions the case of a girl, in whom severe flogging by her mother put a stop to the habit, and patients sleeping away from home, as when visiting among friends, or at a boarding school, sometimes break the habit through an effort of the will. The sense of profound shame which the infirmity produces, thus enables certain patients to control the action of the bladder even in sleep. The state of the mind should, therefore, be considered as an element both in the causation and cure of the infirmity.

8. Malformation of the bladder or its appendages. These are of various kinds. Some of them are of such a nature that cure of the enuresis is difficult or impossible. Thus, Thos. U. Madden, M.D., F.R.S.C.E., relates the case of a young lady, who had been treated by different physicians in various localities with belladonna, iron, vesication of sacrum, and the other usual remedies, without the least benefit. The dribbling of urine was constant day and night, so that she was debarred from schools, and ridiculed and avoided by her associates. She was placed under chloroform, and her bladder was found to have the power to retain a considerable amount of urine. Pursuing the examination, Dr. Madden found that the urine dribbled from a small orifice about half an inch above the meatus urinarius, and covered by rugæ of the mucous membrane. A No. 1 catheter was introduced its entire length through the opening, so that, in the opinion of Dr. Madden, there was malposition and elongation of the right ureter, which, instead of emptying into the bladder, discharged the secretion of the right kidney upon the vulva. In malformations like the above, as well as in ectopia vesicæ, recto-vesical, or vesico-vaginal fistula, the result of abnormal fœtal development, the urine obviously dribbles constantly, and from the moment of birth. In perpetual and life-long dribbling, a malformation or congenital defect is probably the cause.

Prognosis.—The prognosis depends on the cause or causes of the enuresis. Most of the causes are of such a nature that they can be removed, and the majority of patients can therefore be cured by appropriate remedies. Enuresis due to irritating properties in the urine, to

irritation or inflammation in the genital organs or rectum, and that due to exaggerated tonicity of the muscular coat of the bladder, can be for the most part readily cured by appropriate measures, while that resulting from structural disease of the spinal cord, or from malformations in the urinary tract, is least amenable to treatment.

It is the common belief that those epochs in life which produce a decided change in the individual, as puberty or marriage, are likely to effect a cure in cases previously obstinate. This opinion is to a certain extent founded on fact. The development of the sexual organs at puberty seems to render the bladder less irritable and more retentive in some patients. Cases are also related, as one by Trousseau, in which incontinence ceased with marriage and pregnancy. But treatment in the ordinary form of enuresis should not be deferred in the hope that time and physical changes will effect a cure, for this belief is likely to be illusory.

TREATMENT.—The physician asked to prescribe for a case of enuresis should carefully examine the patient in order to ascertain the cause. Since the most common cause is irritability of the bladder, whether inherent in the bladder itself, or imparted to it by the stimulating properties of the urine, the urine should be rendered as bland and unirritating as possible. It should be made, so far as possible, as bland and unirritating as tepid water. This is best accomplished by rendering it neutral. Excessive acidity of the urine, so common a cause of enuresis, is promptly removed by the liquor potassæ administered in doses of a few drops largely diluted. I have found it a safe and efficient remedy in the treatment of this infirmity when the bladder is unduly irritable. If, therefore, in the examination of a case we discover no cause of the incontinence, except an exaggerated contractile power of the bladder, and the urine is acid, from three to five drops of the liquor potassæ should be given three or four times daily, in a wineglassful of gum-water, until litmus paper shows that the urine is neutral, and its neutral state should be maintained.

In belladonna we possess an agent which diminishes the functional activity of the bladder when the latter is in excess. It diminishes the contractile power of the muscular fibres, and its use is, therefore, indicated in the class of cases which we are now considering. In this country the tincture of belladonna is more commonly employed than the extract, which is used in Europe, especially in Continental Europe, and if obtained from a good laboratory its action is as certain as that of the extract, while its dose can be better regulated. Five drops of the tincture may be given every evening, or, if the enuresis be diurnal as well as nocturnal, every morning and evening, to a child of five years, and the dose be increased by one drop every second day if improvement do not occur, and physiological effects are not produced, until the dose is doubled, or even trebled. If the enuresis be relieved, or if, without its relief, physiological effects be observed, as dryness of the fauces, cutaneous efflorescence, or dilatation of the pupils, the dose should not be increased. When belladonna produces the desired effect it is no doubt best to continue its use for some weeks in the dose which is found to be effectual, and then to diminish the number of drops gradually.

Trousseau, who, as we have seen, considered enuresis in most cases a neurosis, highly extolled the treatment by belladonna, believing it the most effectual of all methods of cure. He prescribed the extract of belladonna, gr. $\frac{1}{7}$, or the sulphate of atropia, gr. $\frac{1}{140}$, but he did not state the age of his patients. The dose was increased, if necessary, and whatever dose he found to give relief was administered once daily for three, four, or five months, after which it was gradually diminished, but it was not discontinued until after the lapse of two to ten months. By this treatment, Trousseau states that a majority of his cases were signally benefited, and not a few entirely relieved. The following case, which recently occurred in my practice, indicates the mode of treatment in enuresis when it results from the cause which we are now considering: L., aged eleven years, male, had diurnal and nocturnal enuresis, which seriously interfered with his comfort, and rendered him an object of aversion and ridicule among his schoolmates. He had previously taken belladonna and other remedies without improvement. His urine was found highly acid. Five drops of liquor potassæ were ordered to be given three or four times daily, and the tincture of belladonna, to which he was accustomed, was administered in nine drop doses, three times daily, to be increased, if need be, to fourteen or fifteen drops. The liquor potassæ, in the dose mentioned, immediately rendered the urine neutral, and the enuresis from that time ceased. The treatment recommended above, of rendering the urine as little irritating as possible by neutralizing it, aided by belladonna, which diminished the contractility of the muscular fibres, cured the infirmity, which had been most troublesome and tedious.

If the enuresis be due to an abnormally large secretion of urine, the cause may be such that something can be done to relieve the patient. The liquid ingesta, in the latter part of the day, should be restricted. If it be found that the increased flow is due to diabetes or chronic nephritis, the enuresis, though an unpleasant symptom, is comparatively unimportant, and the grave disease which causes it requires chief attention. The quantity of urine may be diminished in diabetes mellitus by the use of proper food, and in diabetes insipidus by ergot.

Enuresis due to a vesical calculus is associated with symptoms, as we have stated above, which indicate the presence of the stone, such as painful micturition, which may awaken the patient at night, and thus prevent the accident of which we are treating. Urination more frequent and painful in the daytime than at night, occasional interruption in the stream of urine from the impediment, pus, perhaps blood, and an increased amount of mucus in the urine, indicate the presence of a stone. Fortunately, the calculus is easily detected by sounding, and by the present improved instruments it can be crushed and removed, or it can be removed by lithotomy, which, in the opinion of some, is less dangerous, and is preferable to crushing, when the patient is a child.

As we have stated above, the physician should always examine parts contiguous to the bladder, as the genital organs and rectum, in order to ascertain if there be any source of irritation in them which may produce irritability of the bladder by reflex action. In some instances, as we have seen, enuresis rebellious to ordinary treatment ceases when

the irritation in parts contiguous to the bladder is removed. Phimosis, preputial adhesions, the accumulation of smegma between the foreskin and glans, with more or less balanitis produced by the foul products, anal fissure, vulvitis, or ascarides should, if present, receive treatment, and with the removal of the irritating cause the enuresis will probably cease.

Cases in which preputial irritation produces an irritable state of the bladder are not infrequent among the poor of New York, whose habits are frequently degraded and filthy, and the treatment consists in dividing adhesions of the glans to the foreskin, cleaning away the smegma, and using a soothing ointment. The foreskin can, with few exceptions, be sufficiently stretched for this purpose, so that incision or circumcision, which is frequently performed in these cases, is unnecessary.

If the enuresis be due to atony of the sphincter, a remedy is required which acts very differently from belladonna. If weakness of the sphincter be the cause, the indication is obviously to increase its tonicity, and the two medicines which have been most successfully employed for this purpose are nux vomica, or its active principle, strychnia, and ergot. We have stated that the sphincter is more abundantly supplied with nerves than is the muscular coat of the bladder, so that those agents which restore innervation, and thereby increase muscular tonicity, act upon the sphincter more powerfully than upon the muscular coat. Ergot appears to exert a similar action, though, perhaps, less in degree, upon the sphincters of the bladder and anus, to that which it exerts upon the uterine muscular fibres.

We can obtain a clearer idea of the effect of therapeutic agents upon paresis of the sphincter vesicæ by observing their action in paresis of the sphincter ani, for these two sphincters suffer loss of power from the same causes, and recover it by the use of the same agents.

In a very instructive paper on incontinence of feces, published by Dr. George B. Fowler, in the *Amer. Journ. of Obstetrics*, for October, 1882, two cases are detailed, showing unmistakably the beneficial action of ergot in increasing the tonicity of the sphincter ani, and the same treatment is indicated for urinary incontinence when it arises from a similar cause. A child of seven years, in the practice of Dr. Fowler, had been closely confined to his studies, with probably some deterioration of his health, when fecal incontinence commenced. The tonicity of the sphincter ani on examination with the finger did not seem much impaired. Nevertheless it was so increased by ten drop doses of the fluid extract of ergot that the incontinence was relieved. The second patient, an anæmic girl of thirteen years, had been under treatment with iron and other tonics without benefit to the fecal incontinence. Her flesh was flabby and surface cool, and, which is interesting to remark as throwing light on the condition of the vesical sphincter, when it lacks tonicity, a lack of resistance in the anal outlet was very apparent to the touch. A mixture, containing 15 minims of the fluid extract of ergot, and grain $\frac{1}{100}$ of strychnia, was given three times daily. At the end of the first week she had only two recurrences of the trouble, and in three weeks was cured. Four months afterwards, although she had been taking quinine and iron after the discontinuance

of the ergot, a partial relapse occurred, and a suppository of five grains of ergotin, with butter of cocoa, was employed morning and evening. Immediate relief followed, the tonicity of the sphincter was restored, and the suppositories were discontinued after two weeks. The beneficial effects of ergotin in weakness of the sphincters is shown by these cases. Enuresis from weakness of the sphincter vesicæ could not have been better treated than by the same remedies which relieved the fecal incontinence in these two patients.

A considerable number of medicines have been employed with more or less success for enuresis, which are now seldom used. According to Bouchut, M. Ribes was the first who prescribed nux vomica. The patient was a soldier, who had both urinary and fecal incontinence, and was cured of the weakness of the bladder in five days. Nux vomica is employed instead of strychnine, as its use involves less danger. Mondiere prescribed this agent in combination with the black oxide of iron in the following formula:

℞.—Extracti nucis vomicæ . . . . . gr. vj.
Ferri oxidi magnetici . . . . . ʒj.
Ft. pil. No. xxiv. Take one pill three times daily.

Although we accept the statement of Bouchut that strychnia is an "extremely dangerous" remedy for enuresis, if the patients be under the age of four or five years, yet over that age it can be safely prescribed as an adjuvant to the ergot in proper dose, and with proper precautions. A small dose, repeated after three hours, is obviously safer than a larger dose at longer intervals.

Among the remedies not mentioned, which have been successfully employed in certain cases, the tincture of cantharides requires notice. In large doses, this drug causes strangury, but in small doses causes such irritation or stimulation of the surface of the urethra as to increase the contraction of the sphincter, and awaken the patient when the urine presses upon the urethral orifice, which is rendered sensitive by this agent. Cantharides is an unpleasant remedy, and it is not much employed of late years; probably the benefit from its use is not usually permanent. A child of five years can take four or five drops, largely diluted with water, three times daily, and the dose should be gradually increased until there is some evidence of its effect on the outlet of the bladder.

Cubebs, recommended by M. Dieters, the various vegetable tonics and astringents, iron, creasote, and many other remedies have fallen into disrepute, and are now seldom used. Sometimes certain combinations of remedies give prompt and entire relief. Eustace Smith says, "I have lately cured a little girl, aged four years, who had resisted all other treatment, with the following draught, given three times daily:

℞.—Tinct. bellad. . . . . ʒj.
Potas. bromidi . . . . . gr. x.
Infus. digitalis . . . . . ʒij.
Aquæ . . . . . ad ℥ss.—Misce.
Ft. haustus."

The tincture of belladonna of the British Pharmacopœia has about half the strength of that employed in the United States; but, even with

this allowance, I would not dare to prescribe so large a dose of this agent, except that smaller doses were first used, and tolerance of the remedy demonstrated.

Local treatment has been attended by a degree of success. The neck of the bladder and the urethra have been cauterized by the nitrate of silver applied by the porte-caustique of Lallemand, with some relief of the enuresis, at least so long as the soreness remained. Baths and douches of cold water have also been used by many physicians, some of whom, as Underwood, Baudelocque, Guersant, and Dupuytren, state that they have obtained good results. This treatment is most beneficial in those cases in which the sphincter is relaxed.

Finally, in certain patients the advice of Trousseau may be followed, that the patient in the daytime resist the inclination to pass urine so long as it does not greatly increase his or her discomfort; by this means greater tolerance of the presence of urine in the bladder is produced.

Calculi, Dysuria, Cryptorchia.

We have seen, in our remarks on uric acid infarctions, how calculi may form in the pelvis of the kidney, first as small concretions, and how, descending to the bladder they may become nuclei which gradually increase by accretions to their surfaces, or they may form primarily in the bladder. A vesical calculus is not very infrequent, even in the young child. Its presence is manifested by dysuria, and increase of mucus, and the occurrence of pus and sometimes of blood cells in the urine. Occasionally the flow of urine is obstructed by the presence of the calculus, and the consequent tenesmus causes prolapsus ani. Prolapsus ani and dysuria are important symptoms of stone in the bladder. Sometimes the bladder becomes greatly distended with urine, and there may be trickling of it, with œdema and soreness of the prepuce and adjacent parts. Now and then a calculus lodges in the urethra, producing more or less retention of urine, with œdema of the prepuce and adjacent parts. The treatment for calculus must be entirely surgical. Lithotrity as now preformed with improved instruments, is devoid of danger and successful. If a stone lodge in the urethra, it is usually near its outer extremity where the canal is narrowest, and it can be removed by a pair of small forceps.

Dysuria occurs from various causes. It not only results from a calculus, but also from urine concentrated and acid. We have stated above, that urine containing uric acid and the urates if they are abundant is highly irritating, and while this acid and its salts increase the frequency of micturition, they are likely to render it painful. They sometimes cause colicky pain from spasmodic contraction of the muscular fibres in the urinary tract, and even transient albuminuria has been noticed. Dysuria from this cause is best treated by alkaline and mucilaginous drinks.

Dysuria not infrequently arises from a morbid state of the external genitals, and they should always be examined when micturition is painful, or obstructed, to ascertain their condition. In the first two or three

years of life the prepuce is usually adherent to the glans through epidermal cells, which appear to arise from the rete Malpighii, and instead of becoming horny remain soft and filled with protoplasm. This adhesion is so common that it must be considered normal, especially as it does not give rise to symptoms. But occasionally, even in young boys, a pathological state sometimes occurs which gives rise to symptoms, among which is dysuria. Phimosis may be present, retarding the flow of urine, some of which is retained under the foreskin, where, decomposing, it excites balanitis, causes adhesions, and renders urination painful. Circumcision gives relief to the local disease and the dysuria. In the Outdoor Department at Bellevue Hospital, where a considerable number of cases of this kind have been brought for treatment, it has rarely been necessary to circumcise or slit the prepuce. Instead of this, the adhesions are divided by a probe, the prepuce stretched and drawn back so as to expose the glans, and the parts thoroughly smeared with a simple ointment; if there be much inflammation and swelling, it may be necessary to etherize the patient for the operation.

In young girls the labia minora are often adherent, apparently through a catarrhal inflammation. They can, for the most part, be readily separated by traction, when minute drops of blood appear upon the exposed surfaces, showing that a vascular connection has already occurred. Henoch[1] says, "In a few cases this adhesion appears to me to be the cause of dysuria, which disappeared after the separation of the labia from one another; in others examination showed inflammatory redness of the introitus and meatus, with increased secretion of mucus, which renders the excretion of urine painful." Separating the adherent parts and covering the surface with simple ointment to prevent readhesion, suffice to effect a cure of the dysuria when it depends upon this cause.

In the first months of fœtal life the testes lie in the abdominal cavity in front of and a little below the kidneys, behind the peritoneum, and attached to the base of the scrotum by a long cord, the gubernaculum testes. Between the fifth and sixth months the testes descend to the iliac fossa, with corresponding shortening of the gubernaculum. At the end of the eighth month it has descended into the scrotum surrounded by a pouch of the peritoneum, which becomes detached from the peritoneum "just before birth" (Gray), forming a closed sac, the tunica vaginalis. It is estimated that in one case in five, the descent of the testicle is delayed from a few months to a year after birth. Astley Cooper states that the descent does not occur in some cases until between the thirteenth and seventeenth year. When there is this late descent, intestine is apt to follow the testicle, causing inguinal hernia. In about one case in one thousand, it is estimated, the testicle does not descend, but remains in the abdominal cavity, either on account of adhesions to the abdominal viscera, the small size of the ring, or some defect in the gubernaculum. Occasionally, a retained testicle has the normal structure and development, but, as a rule, it is imperfect and small, like the testicle of the infant, and it is prone to fatty or fibrous

[1] Diseases of Children, Wood & Co., 1882.

degeneration. If both testicles are retained, impotence may result on account of the non-development or degeneration. No treatment is required for the retained testicle, unless it become inflamed when lying in the inguinal canal, when it should be treated by poultices and other soothing remedies.

Vulvitis.

Inflammation of the vulva is common in girls under the age of five years. Like most other inflammations, it varies in severity in different cases, from a mild and transient attack to one attended by tumefaction and excoriation or ulceration of the labia, pain, and abundant discharge. Ordinarily when the physician is consulted, the disease has continued a few days, and he finds the vulva moist from a muco-purulent discharge, which dries into light yellow crusts, and produces greenish or yellowish stains on the underclothes. The vulva and lower part of the vagina is sensitive and red, and the acrid secretions sometimes cause redness of the skin over which they flow. Frequently the labia are swollen and tender, the patient may complain of soreness from friction in walking, and sometimes dysuria occurs from extension of the inflammation into the urethra. In severe cases ulcerations or erosions upon the labia result, increasing the distress of the patient.

Vulvitis is sometimes *aphthous*. Small rounded elevations appear upon the vulva, and ulcerate, and the adjacent surface is red and more or less swollen. The ulcers are sensitive and painful, but under ordinary circumstances they progressively heal. Rarely, in those who are markedly cachectic, the ulcers become gangrenous, and recovery is tedious and uncertain.

Etiology.—The most common cause of vulvitis appears to be uncleanliness, and hence its frequency in the families of the poor and degraded in cities. The collection of dirt and sebaceous matter upon the vulva, and the irritation to which it gives rise, which prompts the patient to rub or scratch the parts, cause inflammation. Perhaps among the causes we may mention "taking cold," which excites a vulvitis, as it sometimes does an otitis externa. Struma strongly predisposes to this inflammation, so that slight irritating causes develop it in those who possess this diathesis. A considerable proportion of those who have vulvitis, have or have had other manifestations of scrofula, and present the strumous aspect, so that it seems proper to consider the inflammation of the vulva occurring under such circumstances as possessing a strumous character, or as a local manifestation of the strumous diathesis. We therefore, with Dr. West, regard struma as an important predisposing cause of vulvitis in the child. Ascarides in the rectum have long been recognized as a cause, producing this effect by the intense itching which prompts the patient to rub the parts, and thereby inflame them. It is said that ascarides sometimes crawl to the vulva, and produce inflammation by their presence upon the sensitive surface. A last and most important cause is infection by gonorrhœal pus. Every physician who sees cases in the dispensaries or tenement houses of our large cities, meets cases, even girls of three or four years,

in whom the vulvitis has this cause. Sometimes the gonorrhœa is communicated criminally; in other instances it is contracted from the infected seat of a privy, or from soiled towels or linen. A young man whom I attended, was under treatment for gonorrhœa, when his two nieces of about four and six years were infected by the same disease, probably from soiled towels. Neither the anatomical characters nor microscopic appearances have thus far enabled us to discriminate between gonorrhœal and non-specific vulvitis, but it is not improbable that the differential diagnosis may yet be made by observing the gonorrhœal microbe in the secretions of the one, and its absence from those of the other. In both forms of vulvitis, the muco-purulent secretion and the inflammatory lesions are identical. The danger of infecting the conjunctiva and producing purulent ophthalmia from inoculation with the secretion of vulvitis, is well known. On the other hand, it is believed by some that vulvitis is occasionally caused by inoculating the vulva with the mucopus of ophthalmia.

TREATMENT.—The parts should be frequently bathed with tepid water or mucilaginous water, to insure complete cleanliness. This, with the use of a mild astringent employed with a syringe, suffices in most instances to produce immediate improvement, and in a few days to effect a cure. Vaginal injections of tannin or alum (5: 100), sulphate of zinc (2: 100), or nitrate of silver (1: 100), have been employed with good result in this disease. I have obtained benefit from the following mixture, and more frequently recommend it than any other:

℞—Zinci sulphat. . . . . ℈ss.
Plumbi acetat. . . . . ʒj.
Tinc. opii,
Tinc. catechu . . . . . āā f ʒiij.
Aquæ . . . . . ad. f ℥iv.—Misce.

To be injected warm four or five times daily, through a small glass or gutta-percha syringe. The same should be applied with a camel-hair pencil to the external parts. The following are also useful formulæ:

℞—Ext. opii aq. . . . . ℥j.
Liq. plumbi subacetat. dil. . . . . f ʒjv.—Misce.

℞—Pulv. zinci oxid. . . . . ʒj.
Acecti tannic. . . . . ʒj.
Mucil. acaciæ . . . . . f ʒss.
Aq. rosæ . . . . . f ʒiijss.—Misce.

If ascarides be present, a cold rectal enema of lime-water or salt and water, should be used daily. Benefit may be obtained from rectal enemas of simple cold water even when ascarides are not present.

SECTION V.

DISEASES OF THE CIRCULATORY SYSTEM.

CHAPTER I.

CYANOSIS.

CERTAIN of the diseases which pertain to the circulatory system have been treated of in other parts of this book (umbilical hemorrhage, gastro-intestinal hemorrhage, etc.). It remains to consider that general condition of the blood which is designated morbus cæruleus, or cyanosis.

In 1863, I read before the New York Academy of Medicine a statistical paper on cyanosis, which was published in the *Transactions* of that Society. This paper contains an analysis of 191 cases, collated from the various European and American medical journals, and to those cases I am indebted for most of the following facts pertaining to this disease.

The term cyanosis or blue disease is differently employed by writers Some apply it to cases of transient lividity occurring in the course of acute diseases, as well as to those cases which depend on permanent structural changes, or on malformations. I apply this term, as do most pathologists, only to the latter cases.

The propriety of considering cyanosis as a distinct disease is apparent if we are not misled by the term which designates it. Lividity is not its most important or its essential characteristic. It is simply a sign, although conspicuous, and, indeed, the only one by which the disease can be readily recognized. Cyanosis is, in reality, a blood disease, its pathological state consisting in a deficient oxygenation of this fluid, or in an excess in it of carbonic acid, and probably of carbonaceous products. It should be placed in the same category with leucocythæmia and melanæmia.

Statistics show that cyanosis is, with few exceptions, due to malformation in the circulatory system, and at the centre of circulation, namely, in the heart and in the large vessels which arise from this organ. In exceptional cases the cause of cyanosis is located in the lungs, when it is in all or nearly all instances either emphysema in both lungs, firm and thick fibrinous exudation over the lungs, compressing them by its contraction and causing, perhaps, carnification in parts of them, or the cause is compression of the lungs from caries of the vertebræ, and consequent depression of the ribs. These causes pertain to youth and

manhood, rather than to infancy and childhood. On account of this fact and the rarity of such cases, they need not be considered in this connection.

Literature of Cyanosis.

The ancient physicians, so far as can be ascertained from their writings still extant, were ignorant of cyanosis; whether they overlooked it, or whether those early ages were exempt from it and the malformation on which it depends is peculiar to a posterity physically degenerate. The blue disease described by Hippocrates[1] was probably some acute febrile affection. Galen, whose voluminous writings, with an excellent index, are still extant, and whose comprehensive mind embraced the whole range of medical science of the second century, makes no mention of it, so far as I can find. In the Middle Ages, as appears from the remark of Boerhaave,[2] the common people believed the cyanotic to be the victims of evil spirits; and it is probable that physicians, during this long period of superstition and intellectual lethargy, embraced the popular belief.

On the revival of learning, pathological anatomy began to be more thoroughly and intelligently studied; but it is evident that before the great discovery of Harvey, in the 17th century, it was impossible to refer cyanosis to its true cause. In the latter part of the century so favorably opened by Harvey's genius, malformations of the heart were observed and described by some pathologists on the continent, in cases in which cyanosis must have been present; but it is uncertain, from the brief records which they have left, whether any of them understood the dependence of this disease on the abnormal state of the heart. Boerhaave, in the beginning of the 18th century, attributes "a livid or black color diffused throughout the whole skin," evidently referring to cyanosis, to "1, a relaxation of the vessels, while the *vis a tergo* remains the same, or, 2, to a too sudden increased pressure behind, without a relaxation of the vessels." Vieussens, who was a contemporary of Boerhaave, and was more thorough in the examination of morbid as well as healthy structures, narrated the history of a cyanotic patient, with a description of the malformation, but the one who first gave particular attention to the blue disease was Morgagni. This Paduan professor, excelling his predecessors in thoroughness of observation and accuracy of deduction, published a theory in explanation of the disease which now, after the lapse of more than a century, has many adherents. In the same century with Morgagni, the 18th, but subsequently to his time, Drs. Pulteney, Wm. Hunter, Baillie, Wilson, and Abernethy in Great Britain, and Jurine and Sandifort on the continent, may be mentioned among those who contributed to a knowledge of cyanosis, by the publication of cases, with a description of the malformations. Yet, when the present century commenced, no monograph or dissertation had appeared on this disease; and, notwithstanding the publication of cases from time to time, the pro-

[1] De Morbis, lib. ii. sec. v. page 485, Ed. de Foë's, 1621.
[2] Diseases of the Humors, Acad. Lect., § 732.

fession generally were almost totally unacquainted with its nature. No better idea can be given of the prevailing ignorance, in reference to cyanosis at this period, than by quoting from a case related by Ribes in 1814.[1] The patient had some time previously received an injury of the finger. "Many physicians of Amsterdam," says he, "were at different times consulted on the subject of this affection, no one of whom understood its true cause, its essential character. One considered it as partaking of the nature of epilepsy, and caused by the irritation in the nervous system which the wound in the finger had produced. Others attributed it to the presence of intestinal worms. Some physicians pronounced it an injury of the liver and spleen. Many held it to be a scrobutic affection. One only believed it to be the result of an unknown organic disease."

Since the commencement of the present century the blue disease has received a large share of attention. According to *Forbes's Medical Biography*, the first dissertation on this subject appeared in 1805, from the pen of Seiler, and from this time till 1832 no fewer than twenty-eight dissertations or monographs were published, either on cyanosis or on malformations which produce it or at least relate to it. In the list of writers are some of the most eminent names in the profession, as Louis and Bouillaud. The number who have written on this subject since 1852 probably exceeds the number of previous writers. Of those who have contributed most to our knowledge of the disease may be mentioned Farre, Chevers, and Peacock in Great Britain, Gintrac on the continent, and Moreton Stillé in this country. Farre, Chevers, and Peacock wrote on malformations of the heart, alluding incidentally to cyanosis, but their writings contain valuable matter for statistics bearing on the latter subject. Farre's book was published in 1814, and is out of print; Chevers published his papers in the *London Med. Gazette*, commencing in the year 1845 and running through several successive volumes. Peacock's treatise was published in 1858. It contains several original cases, previously narrated by him to the London Pathological Society. The paper by Moreton Stillé,[2] which has attracted much attention, especially in Europe, was his inaugural thesis.

This paper relates entirely, in the words of the author, to "the laws of the causation of cyanosis." The only really complete statistical paper on the blue disease is that by M. Gintrac, published in 1824, in Paris, and embracing all the cases which had been accurately reported up to that time, namely, fifty-three. He, indeed, exhausted the subject for the period in which he wrote, but on account of the accumulation of material since, his monograph now seems incomplete.

Two theories in explanation of the occurrence of cyanosis have divided the profession: the one attributing it to obstruction at the centre of circulation, and consequent venous congestion; the other, to admixture of venous and arterial blood through openings in the septa of the heart, or through the ductus arteriosus. The former of these theories originated with Morgagni more than one hundred years ago, and is essentially the same as that advocated by Stillé. Stillé errs in placing Morgagni among

[1] Bull. de la Fac. de Méd., 1815. [2] Amer. Med. Jour. of Med. Sci., 1844.

the advocates of the other system. The second theory, or that which attributes cyanosis to admixture of venous and arterial blood, is said by Dr. Peacock to have originated with Hunter, but its ablest supporter was Gintrac. Of late, there are some pathologists who do not believe either theory is sufficient to explain the cause of cyanosis, but that the true explanation lies somewhere between the two. Among the most conspicuous of these is Prof. Walshe, of London. These theories will be considered in the proper places.

Sex.—Writers on cyanosis state that there is a preponderance of males to females affected with it. Aberle, of Vienna, says that two-thirds were males in an aggregate of 180 cases which he collated. In Gintrac's cases, 28 were males, and 16 females; in Stillé's, 41 were males and 31 females. The sex is recorded in 134 of the cases collected by me, of which 78 were males, 56 females; and if those cases are excluded in which cyanosis was due to obstruction at the mouth of the pulmonary artery, the number of the two sexes is the same. In the five years commencing with 1858, according to the mortuary returns, 207 died in this city from cyanosis, of which number 117 were males, 90 females. In England, for two years, 418 males died of cyanosis, and 273 females. Although statistics of different cities and countries agree in the fact of an excess of males over females, there does not appear to be that great preponderance of males which the earlier writers on this disease believed to exist.

Causes of the Malformations.—Mothers sometimes attribute the malformations, and probably correctly, to strong mental impressions felt during utero-gestation. The mother of a patient treated by Dr. Peacock[1] stated that "two months before her confinement, she was frightened by seeing a child killed, and never recovered from the shock she sustained. In another case "the mother was much out of health, and stated that, when pregnant with the child, she was greatly alarmed by seeing a man who was dying of asthma."[2] In another instance the mother was frightened at the fifth month of pregnancy;[3] and in still another case, recorded by Dr. Peacock, the mother, four or five months before her confinement, "was greatly alarmed by her husband, who was insane, standing over her for two hours with a loaded pistol."[4]

Occasionally the malformation appears to be due to some vice or taint in the system of one or both parents. In a case quoted from another continental journal[5] it is stated that "the mother, who had formerly suffered from rickets, gave birth to five children, all of whom died immediately or shortly after birth with symptoms of cyanosis. The father died at the age of thirty-six, of phthisis." Dr. Peacock relates a case in which the father was livid, and had the "pigeon-breast" common in the cyanotic. In the history of a patient, which was communicated by Cooper to Farre, it is related that "vices of conformation of the heart appeared to have been inherent in the family. Of 12 infants only 4 survived, and more presented signs of heart dis-

[1] Malf. of Heart, p. 37.
[2] Op. cit., page 57.
[3] Op. cit., page 41.
[4] Op. cit., page 43.
[5] Gazette Médicale, for December 28, 1850.

ease." Dr. Buchanan relates the history of a child which was the second that had suffered and died in the same family in the same way. A patient treated by Mr. Leonard was the sixth child of a family, who had died at about the same age, with symptoms of cyanosis. Such instances are, however, exceptional. Ordinarily, the cyanotic have not only healthy parents, but healthy brothers and sisters.

A patient whose history is given by Dr. William Hunter was born at the eighth month, but in nearly all other cases the full period of intra-uterine existence was reached.

The opinion was expressed by Gintrac that the number affected with cyanosis to the entire population, varies in different countries. It is probable that the occurrence of the blue disease is not greatly, if at all, influenced by the nationality, but it is certainly dependent, to a considerable extent, on the condition of society. It is less frequent in a community in comfortable circumstances, and engaged in wholesome and quiet occupations. Pure air and outdoor exercise, plain, nutritious diet, freedom from cares and anxieties—in fine, causes which promote the physical well-being, diminish the liability to an ill-formed and cyanotic offspring. And, conversely, impure air, improper and insufficient diet, grief, etc., increase the percentage of cyanotic cases. Hence, it is a rare disease in rural districts, and comparatively frequent in cities, especially in a large city like New York, which contains a numerous indigent and careworn population, living from year to year in the midst of agencies which operate stealthily but certainly to enervate the system and undermine the health.

These remarks are abundantly substantiated by statistics. In New York City for the six years ending with 1860, one death resulted from cyanosis to 436 deaths from all causes; and in Brooklyn the proportion estimated for two years was about the same. On the other hand, in the State of Kentucky, which contains few large cities, and in the death reports of which cyanosis is included in the general term malformation, there was, during a period of five years, one death from malformation to 2469 from all causes. In the State of South Carolina, for three years, one death resulted from cyanosis to 5018 from all causes. In the State of Massachusetts, for two years, there was one death from cyanosis to 1136 from all causes, and two-thirds of the cyanotic cases occurred in the counties of Suffolk, Essex, and Worcester, which contain large cities. In London one death occurred from cyanosis to 755 from all causes during a period of three years. On the other hand, in England, including the city of London, there was, for the ten years ending with 1857, one death from cyanosis to 1589 from all causes; and in the rural districts of Monmouth and Wales only one death occurred from cyanosis to 5578 deaths from all causes during a period of two years.

Time of Commencement.—It is an interesting and somewhat remarkable fact that cyanosis, though dependent on a malformation, does not always commence at birth, or, at least, that it does not exist in degree sufficient to produce the cyanotic hue till some time has elapsed after birth. In 138 of the cases of cyanosis which I have collected, the time at which lividity was first observed is stated as follows: In 97 it

was within the first week, and generally within a few hours of birth. In the remaining 41 cases it commenced as follows:

In 3 at 2 weeks	In 6 from 2 years to 5 years
" 1 " 3 "	" 1 " 5 " " 10 "
" 2 " 1 month.	" 6 " 10 " " 20 "
" 7 from 1 to 2 months.	" 1 " 20 " " 40 "
" 5 " 2 " 6 "	" 1 over 40 years.
" 5 " 6 " 12 "	—
" 3 " 1 year to 2 years.	41

In these 41 cases, in which blueness did not occur till after the age of one week, if the patient were less than two years old when it commenced there was frequently no obvious exciting cause, but above this age, with three exceptions, such a cause is known to have been present. It is interesting to observe how trivial the exciting cause frequently is, and equally interesting to note how long patients have enjoyed good health, not having the least lividity, although the anatomical vice, to which the final development of cyanosis was due, had existed from birth.

Dr. Theophilus Thompson[1] relates the history of a lady, thirty-eight years old, who was well till an attack of Asiatic cholera, after which her health was permanently impaired. Two years before her death she passed through a course of fever, and from this time was cyanotic. Dr. Waters[2] relates a case in which cyanosis began at the age of six years in an attack of measles. In a case published by Mr. Napper,[3] the child fell at the age of six months, and from this time had cyanosis. A female, whose history is given by Prof. Tommasini, of Bologna, and quoted by Bouillaud, became cyanotic at the age of twenty-five in consequence of difficult parturition. Mr. Stedman[4] relates a case, in which cyanosis began at the age of ten weeks in an attack of convulsions. Dr. John P. Harrison[5] published the history of a baker, twenty years old, in whom cyanosis began five years previously after great effort in carrying wood. Louis and Bouillaud quote from M. Caillot the case of a child, who became cyanotic at the age of two months in an attack of hooping-cough. Louis also narrates a case in which hooping-cough had the same effect at the age of twelve years. Ribes treated a child in whom the blue disease began at the age of three years from a severe contusion of the fingers. In a case related by Marx it commenced at the age of ten months from a blow on the back, inflicted by the mother. Mr. Speer[6] gives the history of a female, who at the age of thirteen years was put in a place requiring considerable exertion, and from this time was cyanotic. A patient, whose case is related by Cherrier, fell into a deep ditch in the winter season, and immediately after had a low fever, from which the blue disease commenced. In a case published by Tacconus the exciting cause was believed to be fright, in consequence of a fall from a great height, and in another, related by Bouillaud, it was

[1] Medico-Chir. Trans., vol. xxv.
[2] Philadelphia Medical Examiner, June, 1850.
[3] London Medical Gazette, 1841.
[4] London Lancet, 1842.
[5] American Journal of Medical Sciences, 1847.
[6] Medical Times and Gazette, for 1855.

a blow received on the epigastrium after the patient had passed the age of fifty years. Similar cases are related by Mayo and Peacock.

It will be seen that the exciting cause of cyanosis is usually such as produces a profound impression on the system, and affects the action of the heart. Precisely in what way it operates to develop the disease has not been satisfactorily explained. Mr. Mayo conjectures, that in the case related by him there was previously some compensation which ceased, or became inadequate in consequence of some change produced in the economy. Although cyanosis may not appear for months or even years, there is rarely improvement when it is once established. Appearances of amendment are deceptive. The disease when not stationary is progressive, and this explains the fact that few survive the middle period of life.

Symptoms.—The symptoms in cyanosis vary in intensity in different patients, and in the same patient at different times, being milder if he be quiet and the mind calm, more severe if active, or if the mind be agitated. In mild cases, in a state of rest, they nearly or quite disappear, so that a stranger would not suspect that there was any serious ailment. They are aggravated by any cause which accelerates the action of the heart. In some patients, cyanosis is increased by the most trivial disturbing influences, among which may be mentioned nursing, dentition, crying, coughing, and slight emotions of joy, sorrow, or anger. In more than one case it has been perceptibly increased by the stimulus of digestion, the color being deeper after a full meal than before.

The cyanotic hue varies in different individuals from duskiness to a deep purple, almost black color. It is usually most marked in the visage, especially the palpebræ, cheeks, nose, and lips, in the ears, fingers, and toes, and upon the mucous surfaces. It is sometimes, without any assignable cause, confined to a portion of the body. In a case related by Mr. Steel,[1] the upper part of the body was livid and œdematous, and the lower part pallid and shrunken, and yet the malformation was of the kind which is commonly present in cyanosis. In the *London Medical Times*, March 8, 1845, copied from the *Gazette Médicale*, is the history of a child six years old, in whom the color was deeper on the right than left side. There had been, however, hemiplegia of this side in infancy, but this had entirely passed off. On the other hand, in a case of rare malformation communicated by Cooper to Farre, in which the upper part of the system was supplied chiefly by arterial and the lower by venous blood, the discoloration was general. In exceptional instances livid maculæ, like those of purpura, have been observed upon the skin.

Those affected with cyanosis have generally at birth been well formed and of the usual size, and in most cases, for a considerable period after birth, the appetite is good, bowels regular, and the system well nourished. But when cyanosis becomes so severe, as it does sooner or later, that its symptoms are rarely absent, digestion is imperfectly performed, and the body becomes either emaciated or stunted and puny. It may be stated, as a rule, that nutrition is in inverse proportion to the gravity of

[1] London Lancet, 1838.

cyanosis. In thirty-three out of forty-one cases, in which the condition of the system, as regards nutrition, was recorded either a short time previously to death or at the autopsy, the body was either considerably emaciated or else diminutive, and those who were well nourished were usually such as had died early, or of some intercurrent disease.

In this connection may be mentioned two abnormalities which have been observed in the cyanotic. The chest is often flattened laterally, with a projecting sternum, so as to present an appearance generally described in the records as "pigeon-breasted." Sometimes the most prominent part is directly over the heart, and in one or two cases the sternum was observed to be deflected toward the left. In the majority of the records, however, no mention is made of the external appearance of the chest.

The other abnormality is frequently observed in chronic diseases of the heart and lungs, in which there is sluggish circulation and consequent altered nutrition in the fingers and toes. In twenty-eight cases it is stated that the tips of the fingers or toes, or both, were bulbous. This hypertrophy, if slight, is likely to be overlooked, and that it was observed and recorded in so many cases renders it probable that it was present in a much larger number. In one case the anatomical character of this enlargement was examined, and was found to consist chiefly of hypertrophied connective tissue.

The nails are often incurvated over the deformity. At a meeting of the Lond. Path. Soc., in 1859, Mr. Ogle narrated the history of a laborer, fifty years old, who had swelling, numbness, and lividity of the left arm, from pressure of an aneurism, and the fingers on this side were clubbed as in cyanosis. A patient whose history is related in the *Glasgow Medical Journal*, and who was believed to be cyanotic in consequence of a highly emphysematous state of the lungs, had a similar development of the tips of both fingers and toes.

An interesting feature in cyanosis is the low grade of animal heat. The temperature of the body is in all cases below that of health. This is especially noticeable in the extremities. There has not been a sufficient number of accurate thermometric observations to determine whether the internal heat is usually reduced. The following only have been recorded: Mr. Fletcher[1] relates the history of a young man, in whom the thermometer placed in the mouth did not rise above 80° Fahrenheit. Hodgson reports the case of a man, twenty-five years old, in whom the thermometer placed under the tongue rose to 100°, while in his own case it was two or three degrees below that term. In an experiment, recorded by Nasse, the instrument placed in the mouth fell little if at all below the healthy standard; applied to external parts, it stood at about 21° Réaumur.

The lack of heat is the source of great discomfort to a cyanotic patient. In mild weather he requires a fire to keep him warm, or an amount of clothing which to others would be intolerable, and in cold weather slight exposure strikes him with a chill. Nor can he increase his heat by active exercise, since his infirmity disqualifies him for this.

[1] Medico-Chir. Tran., vol. xxv.

Although the temperature of the surface is so low, the occurrence of perspiration, sometimes profuse, is mentioned in several of the records.

In severe cases of cyanosis the generative system is imperfectly developed. In the female, menstruation is scanty or delayed, and in the male signs of puberty are feebly manifest. If the disease be so mild that the symptoms are absent when the patient is in a state of repose, these organs attain nearly or quite their normal development. The catamenia have appeared as early as the age of sixteen years; and a cyanotic patient treated by Cherrier had two children, but they both died of scrofulous affections.

The action of the heart is necessarily much involved. In mild forms of the disease, if the patient be quiet, this organ may beat with considerable slowness and regularity, but in all cases exercise or excitement, which in a state of health would scarcely have any appreciable affect on the pulse, embarrasses its movements, and produces palpitation. In severe cases palpitation is rarely absent, and the pulse is frequent, feeble, and often intermittent. In a large proportion of patients bruits are produced by the irregular circulation through the heart.

The respiration corresponds with the action of the heart. It is accelerated in proportion to the frequency of the pulse. The suffering in this disease is largely due to paroxysms of palpitation and dyspnœa. These occur sometimes without any apparent exciting cause, and when the patient is quiet, but they are commonly induced by those causes which we have already mentioned as aggravating the symptoms of cyanosis. They come on suddenly, and are attended by increase of lividity, distention of the jugulars, and sometimes of the cutaneous veins, and by a sensation of present suffocation. They last only a few minutes, and are succeeded by great depression of the vital powers. In infants, on account of greater nervous irritability, and feeble power of endurance, these paroxysms often end in convulsions, which occasionally are fatal. A cough is sometimes present, but is usually slight.

Pain is not a common symptom. Some of the patients complain occasionally of headache, with or without vertigo, and occasionally also of pain in the chest, but it is uncertain to what extent or whether these symptoms are dependent on the cyanotic disease. The secretions do not appear to be affected, so far as has been ascertained. The same may be said of the intellectual and moral faculties. In a case related by Dr. Chevers,[1] the child was even said to be precocious. The mind is capable of steady application and acquisition, as in health, provided that the emotions are not unduly excited.

Those who are affected with cyanosis are liable to various forms of hemorrhage, but this liability, if we may judge from recorded cases, is greater in youth and adult life than in infancy. In two cases blood was vomited, in one passed by stool, in one it escaped from the gums, in two from the mouth, in eight from the nostrils, and in sixteen it was expectorated. Pulmonary phthisis was, however, usually present in these last cases. An interesting case is related by Dr. Wm. M. Voris,[2]

[1] Lond. Med. Gaz., vol. xxxviii.
[2] Western Journal of Medicine for 1829.

of a girl, nine years old, in whom hemorrhage occurred under the scalp, producing great tumefaction, and nearly closing the eyelids. An incision was made, from which a pint and a half of dark blood escaped, and it was estimated that more than half a gallon was lost during the ensuing two weeks, at the expiration of which time the incision closed. The patient recovered from the hemorrhage, but not from the cyanosis.

Toward the close of life more or less anasarca occasionally occurs, especially around the ankles, sometimes in the eyelids and face, and rarely to a certain extent over the whole body. In certain patients it coexists with effusion in the serous cavities.

It is evident that one who is affected with the severe form of cyanosis is disqualified for the duties of active life. The sports of childhood and the useful labors of mature years require an exertion for which he is physically unfit. He has not the ability even to engage in animated conversation, for he is overcome by emotions, whether of joy or sorrow. He lives almost an idle spectator of the world around him, prevented by his infirmity from engaging in its pursuits.

Intercurrent diseases, especially those of childhood, are badly tolerated; but hooping-cough is the one which these patients are especially ill-fitted to endure. Still, they sometimes pass safely, not only through hooping-cough, but through some of the most dangerous febrile diseases. It is a question of interest, but about which little is known with certainty, whether these intercurrent maladies are influenced by the cyanotic or venous condition of the blood. The symptoms of these maladies are no doubt more alarming, mainly on account of the embarrassed action of the heart, and not on account of the state of the blood; still it is reasonable to suppose that malignant and asthenic diseases are rendered worse by the lack of oxygen, and excess of carbonic acid in the circulating fluid.

Probably cyanosis does not furnish immunity from any other disease, although this statement has been made on a high authority. Rokitansky says: "*All forms of cyanosis, or rather all diseases of the heart, great vessels, and lungs, adapted to produce cyanosis, in a greater or less degree, cannot coexist with tuberculosis. Cyanosis affords a complete protection against it, and in this circumstance may be found an explanation of the immunity from tuberculosis which many conditions of the system, apparently very different in their character, afford.*"[1] This opinion of the distinguished pathologist, notwithstanding his ample opportunities for observation and known accuracy as an observer, is not substantiated by statistics. So far from its being true, the low degree of vitality in cyanosis appears to favor the occurrence of tubercle. I have records of twenty-six cases of cyanosis in which tuberculosis was also present, in several of which the lungs contained cavities. This is about thirteen per cent. of the whole number in my collection—a large proportion, since so many die in early infancy, at which period the tubercular disease is not apt to occur. Cyanosis appears, also, to favor the development of cerebral diseases, especially congestion and coma, as will be seen presently.

[1] Hand. der Pathol. Anat., II. Bd.

PROGNOSIS.—This is unfavorable. Most cyanotic individuals die young. The age which they attain has been made the subject of statistical inquiry by Aberle. He states that in an aggregate of 159 cases, 57, or 35 per cent., died before the end of the first year; 108, or more than two-thirds, died before the age of eleven years; 30 between the ages of eleven and twenty-five years; and of the remaining 21, only 5 lived more than forty-five years.

The age at which death occurred, is given, in 186 of the cases collected by myself, as follows:

In 17	under the age of 1 week.		In 21	from 5 years to 10 years.	
" 10	from 1 week to 1 month.		" 41	" 10 "	" 20 "
" 12	" 1 month to 3 months.		" 20	" 20 "	" 40 "
" 11	" 3 months to 6 months.		" 4	over 40 "	
" 17	" 6 " to 12 "				
" 12	" 1 year to 2 years.		186		
" 21	" 2 years to 5 "				

Sixty-seven, then, or more than one-third, died before the close of the first year; 121, or more than three-fifths, before the age of ten years; only 24 survived the age of twenty years, and 4 the age of forty years. Of course, the duration of life depends on the nature and extent of the malformations. Some of these are such as to render a speedy death inevitable.

MODE OF DEATH.—The mode of death is recorded in ninety-five cases, as follows:

19	died in a paroxysm of dyspnœa.
10	" suddenly (the exact manner not stated).
14	" in convulsions (infants).
2	" of apoplexy.
7	" from hemorrhage.
6	" of phthisis (though, as we have seen, twenty others had this disease).
2	" of exhaustion, without hemorrhage.
10	" of coma.
2	" of abscesses in the brain.

One died of each of the following diseases: cerebral irritation, congestion of brain, effusion in the cranial cavity, acute hydrocephalus, paralysis from acute softening of the brain, dysentery, inflammation of heart, syncope, mucus in the air-passages, thoracic inflammation, choleraic diarrhœa, pneumonitis, bronchitis, scarlet fever, croup. One died in trying to walk, one after a spasmodic cough in pertussis, one after a long agony, one after an agony of ten or eleven hours; one is recorded to have died gradually, and three quietly.

The ten who are stated to have died suddenly probably died in paroxysms of palpitation and dyspnœa, which, we have seen, are easily excited, and of common occurrence in cyanosis. If so, this was the mode of death in 29 cases. Infants, with few exceptions, so far as appears from the records, died in convulsions. Nineteen died of cerebral affections, exclusive of convulsions, and in thirteen of these the cause of death was congestion, apoplexy, or coma. The hemorrhage of which seven died was probably, in most instances, dependent on phthisis, and six are said to have died directly of phthisis. We may, then, regard paroxysms of

palpitation and dyspnœa, convulsions, congestive affections of the brain, and phthisis, as common modes or causes of death in cyanosis.

The malformations of the heart and great vessels which give rise to cyanosis are quite numerous. The following table exhibits their character and relative frequency:

	Cases.
1. Pulmonary artery absent, rudimentary, impervious, or partially obstructed	97
2. Right auriculo-ventricular orifice impervious or contracted	5
3. Orifice of the pulmonary artery, and the right auriculo-ventricular aperture impervious or contracted	6
4. Right ventricle divided into two cavities by a supernumerary septum	11
5. One auricle and one ventricle	12
6. Two auricles and one ventricle	4
7. A single auriculo-ventricular opening; interauricular and interventricular septa incomplete	1
8. Mitral orifice closed or contracted	3
9. Aorta absent, rudimentary, impervious, or partially obstructed	3
10. Aortic and left auriculo-ventricular orifices impervious or contracted	1
11. Aorta and pulmonary artery transposed	14
12. The cavæ entering the left auricle	1
13. Pulmonary veins opening into the right auricle or into the cavæ or azygos veins	2
14. Aorta impervious or contracted above its point of union with the ductus arteriosus, pulmonary artery wholly or in part supplying blood to the descending aorta through the ductus arteriosus	2
Total.	162

From the above table it appears that in more than one-half of the cases of cyanosis the congenital vice which gives rise to it is located in the pulmonary artery. It is located also, in general, in that part of the artery which is nearest the heart. Its character is different in different cases. Sometimes there is an arrested development of this vessel, and in its place we find simply a ligamentous cord extending from the heart as far as the ductus arteriosus, while beyond this point the artery and its branches are pervious; rarely the entire artery is ligamentous, and of course impervious; in other cases this vessel is open through its whole extent, but the part nearest the heart is so small as to be properly considered rudimentary; in others still, there is adhesion of the valves to each other as the chief congenital defect, and, finally, in rare instances the obstruction in the pulmonary artery is due to an adventitious membrane, which stretches across the vessel like a diaphragm. These last malformations, namely, adhesion of the valves and the formation of an adventitious membrane, are doubtless due to inflammation occurring in the artery before birth, and some attribute the arrested development and ligamentous state of the vessel to the same cause.

In most cases of cyanosis, due to obstructive malformations, the interauricular and interventricular septa are more or less deficient. This deficiency obviously results from the obstruction, for the septa are formed in the heart after fœtal circulation is established, and the blood, being prevented by the vicious formation from flowing in its proper channel, necessarily passes to the opposite side of the heart. More or less blood being forced from one auricle or one ventricle to the opposite cavity, it is evident that a permanent aperture must result in the septum. The

aperture in the septum ventriculorum is ordinarily at its base; in the septum auriculorum it corresponds with the foramen ovale.

In most of the obstructive malformations one and rarely two abnormal cardiac murmurs have been observed. The single murmur accompanies the ventricular contraction. As it has been observed in cases of complete as well as incomplete obstruction, it seems to be due mainly to the flow of blood through the apertures in the septa.

Modes of Compensation.—In most cases of cyanosis the congenital defect is partially obviated by modes of compensation. In the most frequent malformation, that in which there is obstruction in the pulmonary artery, and a considerable part if not all the blood flows directly from the right to the left side of the heart, the ductus arteriosus not only remains open, but is greatly enlarged, through which a current of blood enters the pulmonary artery from the aorta, and passing to the lungs is oxygenated. The bronchial arteries have also been found greatly enlarged, and it is believed that though they are the nutrient arteries of the lungs, the blood which they convey to these organs is decarbonized in its circuit through them. In a case published by Mr. Le Gros Clark,[1] the bronchial arteries were not only enlarged, but a "branch from the internal mammary artery, which accompanied the phrenic nerve, was nearly equal in size to the parent trunk, and expended itself principally in the adjacent adherent lung." Branches of the intercostal arteries have also been found enlarged, and entering the lungs, or connecting with vessels which enter the lungs. By such modes of compensation cyanosis is rendered milder, and life is prolonged. To these we must attribute the fact that some have very considerable malformation, and yet do not become cyanotic.

Morbid Anatomy.—This, as regards the circulatory system, has been sufficiently dwelt upon. No chemical analysis, so far as I am aware, has yet been made of cyanotic blood. We know that it is dark, its coagulability feeble, that it contains an excess of carbonic acid, and is deficient in oxygen. From the nature of cyanosis, it would be inferred that in many cases there is a degree of passive congestion in the cavities of the heart, and consequently in the capillaries of the general system, giving rise to more or less serous effusion. Statistics show that this is so. The quantity of pericardial fluid is in some patients increased. I have records relating to this fluid in fifty-one cases. Usually it was pure serum. In seventeen the quantity was half an ounce or less, if we include in the number those in which the amount is expressed in such terms as "due quantity," "usual amount," and "small amount." In twenty-four cases the pericardial fluid (serum) exceeded half an ounce, usually estimated at from one to six ounces, but in two it exceeded the latter quantity. It one of the twenty-four this fluid was stained with blood. In two patients the records state that there was a small quantity of pure blood in the pericardium, and in one the two pericardial surfaces were agglutinated by inflammation.

In some of the autopsies serum was found in the pleural cavities, usually in connection with pericardial effusion, and in at least one in-

[1] Medico-Chir. Trans., vol. xxx.

stance this fluid was tinged with blood. Old adhesions between the costal and pulmonary pleura were observed in a few instances. The condition of the lungs was recorded with more or less minuteness in one hundred and ten cases. Mention has already been made of the large number affected with tubercular disease, which was either confined to the lungs, or was chiefly exhibited in these organs. In thirty-five patients the records state that the lungs were of small size, either by compression, or sometimes, apparently, from the continuance of the fœtal state over a greater or less portion of the organ. The compression was produced either by the distended pericardium or by effusion in the pleural cavities. In thirty-five cases the lungs presented a dark color. This hue in some specimens accompanied the unexpanded or fœtal state of the organ, but in others there was the normal inflation, and the dark color was due to engorgement or congestion. In other cases the lungs are stated to have been natural, except the color. In nine emphysema was present in a part of the lungs, in two pneumonitis; in two the color of the lungs was pale, in one a bright crimson; in one the lungs were larger than natural, in one the right lung was absent, and in seventeen these organs were recorded healthy.

I have records of the state of the liver in twenty-six cases, in sixteen of which it was enlarged, and in four of these it was congested. Congestion of the liver was present in eight other cases, in which no mention is made of its volume. The parenchyma of this organ had a natural appearance in nine cases, but in some of these there was enlargement. From these statistics it is probable that the liver is commonly enlarged in cyanosis, and not infrequently congested. In a few cases the condition of the other abdominal viscera is mentioned; in some as healthy, in others as congested. Fifteen examinations of the brain were made, in seven of which congestion is recorded, and in three abscesses in the cerebral substance, in one of which cases the lateral ventricle was also filled with pus; in two softening of a portion of the brain had occurred, in three the brain was firm or compact, in three the quantity of fluid in the cranial cavity exceeded the normal amount, and in one it was less than normal.

Theories Relating to the Etiology of Cyanosis.—Although in nearly all cyanotic patients there are direct communications between the two sides of the heart, it is shown by many observations that these communications or apertures are not sufficient in themselves to produce cyanosis. This opinion was expressed half a century ago by Louis, who published an excellent monograph on the subject of these communications, basing his remarks on an analysis of twenty cases. Since the publication of this paper, the belief has been pretty general in the profession, and observations continue to substantiate it, that, although the apertures may be of considerable size, if the two sides of the heart, with their orifices and vessels, are in their normal state, so that they act symmetrically and without obstruction, cyanosis does not occur. In proof of the correctness of this opinion many cases might be cited of a pervious, and some of a largely dilated foramen ovale, without the cyanotic hue, cases which have been published in the journals since the appearance of Louis's monograph. Still, in cases of obstructive mal-

formation, unless the obstruction be complete, cyanosis is more likely to occur in consequence of these apertures, for were they absent a larger amount of blood would be propelled through the narrowed orifice, and a larger amount consequently be oxygenated.

Allusion has already been made to the two theories which prevail in the profession; oneattributing cyanosis to the intermingling of venous and arterial blood; the other to obstruction at the centre of circulation, and consequent venous congestion. There are serious objections to the acceptance of either theory as an explanation for all cases. That admixture of the two kinds of blood is not essential to the production of cyanosis, is apparent from the following facts. In one case in the *Fourth Malformation*, there was no communication between the two sides of the heart, and the ductus arteriosus was closed, so that admixture was impossible. Again, in the *Eleventh Malformation*, or that in which the aorta and pulmonary artery are transposed, the blue disease evidently does not depend on the admixture of the two currents. On the other hand, in this curious state of the heart, the more the admixture the less the cyanosis, since the only way in which the systemic current of blood can be arterialized is by passing to the opposite side of the heart. An argument against this doctrine may also be found in the fact that the modes of compensation are not such as in any way diminish or obviate the admixture. It is admitted that in the more frequent malformations cyanosis is increased by the apertures, which allow the intermingling of the venous and arterial currents, but it is more reasonable to consider the intermingling and the cyanosis as the direct results of the malformation, neither having precedence of the other, than to consider that they are related to each other as cause and effect, or as proximate and remote results. Viewed in this light, the admixture must be considered simply a concomitant of the cyanosis.

The second theory, that of venous congestion, has numbered among its advocates many who have given special attention to the subject, as Morgagni, Louis, and Stillé, but it seems to have even less claim for acceptance than the theory of admixture. It has been seen that in nearly all cases of cyanosis the two sides of the heart communicate freely, so that if the current of blood meet with an obstruction, as it commonly does, it readily escapes to the opposite side where the artery is large and gives it free passage. In this way congestion, if not prevented, is greatly diminished. Again, it will be seen that, although certain of the viscera are frequently found at the autopsy more or less congested, congestion is not uniformly present in the organs, as it would probably be were it the proximate cause in all cases of cyanosis.

Moreover, in some patients the malformation is not obstructive. The cavities and their orifices are of the normal size, and cyanosis is due entirely to malposition of the vessels. It cannot be said that in these cases there is venous congestion from arrest at the centre of circulation. If there be any congestion, it must be due to the fact that venous blood does not circulate as readily as the arterial in the capillaries. It is true that in the paroxysms of dyspnœa there is sometimes more or less congestion; the distention of the jugulars shows this, but it subsides with

the paroxysms, and it probably is no more than usually occurs when the respiration is greatly embarrassed.

In fine, attempts to express the immediate pathological state producing cyanosis in the terms of a general law have failed. However plausible the above theories may appear in regard to certain cases, there are others to which they are manifestly inapplicable. Those who advocate these theories seem to lose sight of the obvious fact that the chief want of the economy in cyanosis is decarbonization of the blood, and it is hardly supposable that there can be any correct theory of its causation which is not founded on this fact. With this physiological state in view, it does not seem difficult to express a theory in comprehensive terms which is applicable to all cases, such as the following: *Cyanosis is due to vices or defects in the organism, usually congenital, which prevent the free and regular flow of blood to, through, or from the lungs.* So comprehensive a statement includes not only cases of malformation and malposition of the heart and its vessels, but also those few cases in which the lungs are in fault. In most patients, as we have seen, the current of blood *toward* the lungs is obstructed, and the current of blood *from* the lungs, in those comparatively rare cases in which the malformation is on the left side.

TREATMENT.—From the nature of cyanosis it is evident that the treatment should be more hygienic than medicinal. The patient should be warmly clad and kept in a warm room, and all agencies calculated to embarrass or disturb the functions of the body or excite the emotions, and thereby accelerate the heart's action, should be studiously avoided. The diet should be nutritious, but simple and easily digested.

Those who have attributed cyanosis wholly to apertures in the interauricular and inter-ventricular septa, and the consequent flow of blood from the right to the left side of the heart, have considered it an important part of the treatment to keep the patient reclining on the right side, so as to diminish this flow by the effect of gravitation. The reader, however, must be convinced from the nature of the malformations that little benefit can accrue from following such advice. Still, patients are sometimes less cyanotic and more comfortable in one position than another. In a case reported by Mr. Howship,[1] "the only easy and indeed comfortable position in which the child could remain was that usual in nursing. When erect, the dusky color of the face and neck became a dark blue." In a case related by Mr. Spackman,[2] the patient was easiest on the hands and knees. Louis[3] reports a case in which the selected position was with the head elevated; Wm. Hunter,[4] a case in which the patient avoided paroxysms by lying on the left side. Struthers and King[5] each report a case in which the patients seemed most comfortable while lying on the right side; while, on the other hand, Professor White,[6] of Buffalo, and Dr. Jas. Carson,[7] report cases in which position on the right side failed to produce any alleviation of symptoms. Other similar observations might be cited, but enough have been men-

[1] Edin. Med, Journ., 1813.
[2] Lond. Med. Gaz., 1833.
[3] De la Commun. des Cav., etc.
[4] Med. Obs. and Enq., vol. vi.
[5] Monthly Journ. of Med. Sci.
[6] Buff. Med. Journ., 1855.
[7] Amer. Journ. of Med. Sci., 1857.

tioned to show that no one position should be recommended for cyanotic patients. Some obtain most relief by lying on the back, others on the right side, others on the left, some when on the hands and knees, some when reclining on either side indifferently, while, finally, others suffer least when erect.

There was a time when the paroxysms were treated by venesection, but depletion has long since been abandoned. Physicians now rely on stimulants, antispasmodics, friction to the chest, and mustard pediluvia, to relieve the urgent symptoms, although this treatment is but partially successful. It is probable that of all internal remedies digitalis is the most useful, from the fact that it is an efficient heart tonic, and more than any other medicine gives strength and equality to the heart beats. In cities, where oxygen gas can be procured for daily inhalation, it seems not improbable that the urgent symptoms may in some instances be partially relieved by the use of this agent.

SECTION VI.

SKIN DISEASES.

CHAPTER I.

ERYTHEMATOUS DISEASES.

UNDER this head are included erythema, roseola, and urticaria. They consist in an active congestion, inflammatory it is believed, of the skin, which soon declines, with or without slight furfuraceous desquamation. The color of the affected cuticle is bright red in erythema, rosy in roseola, and pale red in urticaria. Febrile symptoms often precede for a few hours the occurrence of the eruption, and they abate as it appears.

Erythema.

The eruption of erythema occurs in patches of different sizes, the largest ordinarily not exceeding four or five inches in length, and most of them have considerably smaller dimensions, their margins being in some instances diffused, and in others circumscribed and well defined. The patches are slightly swollen from engorgement of the capillaries of the skin and slight serous effusion, and are accompanied by a sensation of heat and itching.

Erythema is idiopathic or symptomatic. The *idiopathic* form is subdivided into erythema simplex, intertrigo, and læve. Erythema simplex is produced by external agencies of an irritating nature, as heat, cold, friction, chemical and mechanical irritants, applied to the skin. A common example of this form of the disease is the efflorescence about the anus in cases of infantile diarrhœa due to acidity of the evacuations. Erythema intertrigo is produced by the friction of opposing surfaces of the skin, and it therefore occurs mainly in the folds of the neck, about the groins, and behind the ears. This inflammation is sometimes slight, disappearing in two or three days with proper treatment; in other cases the epidermis becomes denuded, the surface is tender and moist, and even superficial excoriations occur. In severe cases the ulcers extend more deeply and give rise to considerable purulent discharge, the skin and even subcutaneous connective tissue being more or less infiltrated and indurated. The confinement of the perspiration, and the moisture,

which is exuded between the folds of the skin, increase the inflammation. The effused liquid does not in ordinary cases stiffen linen, as in eczema. Erythema læve is the name applied to the inflammatory hyperæmia of the skin, which often occurs over œdematous parts. Its most common seat is about the ankles and upon the legs. In children it is most frequently observed in the œdema which results from scarlatinous nephritis and from heart disease.

Symptomatic erythema, which results from a general or constitutional cause of a pyrexial character, has several subdivisions. The simplest and mildest form of it is erythema fugax, which comes and goes quickly. The erythema which occurs upon the features in acute meningitis is a typical example. It is common in various inflammatory and febrile affections. If the erythematous patch be circular, with normal skin in its centre, it is sometimes designated erythema circinatum, and, if the margin be well defined, marginatum. Erythema papulatum, tuberculatum, and nodosum are applied to the same form of the disease, one or the other term being employed according to the stage or size of the eruption. In erythema papulatum the eruption begins as small red spots, which soon become papular, and attain a size varying from that of a pin's head to a split pea. It occurs especially on the neck, breast, arm, and back of the hand, and fades away, with a slight desquamation, in about three weeks. In erythema tuberculatum and nodosum the eruptions have a greater diameter, and are usually more prominent. In the latter variety they often have a diameter of two or more inches, and occur most frequently upon the anterior aspect of the leg. These three forms of erythema, which may be described as one, occur chiefly in young people. Erythema tuberculatum is most common in servants, especially those recently from the country. The tumefaction is due to the effusion of serum in the corium, and, when the eruption has considerable prominence, also in the subcutaneous connective tissue. The color is at first a bright red, then dark red or purple, and it fades away like the discoloration of a bruise as the eruption declines. Rheumatism is often and diarrhœa occasionally associated with these forms of erythema, and rheumatic pains are occasionally present, as well as more or less febrile movement.

Prognosis.—This, as regards the erythema, is always good. An unfavorable result in any case is due to cachexia, or some coexisting disease. The duration of the milder cases is only a few hours, while cases of a more severe type, as erythema nodosum, last two or three weeks.

Diagnosis.—The ordinary forms of erythema are distinguished from *erysipelas*, by the absence of any very decided burning pain, and tumefaction of the integument, and tendency to spread, and by less marked constitutional symptoms. In those cases of erythema in which there are infiltration and swelling of the skin and subcutaneous connective tissue, the patches are distinguished from those of erysipelas by being multiple, of smaller size, less hot and painful, not extending, and presenting as they disappear the phenomena of a bruise. In *urticaria* the wheals that come and go suddenly with a peculiar stinging sensation, and the irritability of the skin in consequence of which these wheals are pro-

duced by slight friction, differ so much from the symptoms and appearances of erythema that the differential diagnosis of the two is easy. In *roseola* the eruption ordinarily occurs over a large part, if not the entire surface, in points and small patches with healthy skin between, and presenting a rosy instead of a bright red color, characters which sufficiently distinguish it from erythema. Erythema when extensive is sometimes mistaken for the scarlatinous eruption, but the redness of the fauces, graver constitutional symptoms, vomiting, persistence of the eruption, etc., serve to distinguish the latter from the former affection. In cases of doubt it is proper to defer the diagnosis for a day or two, when if the rash be erythematous it will fade. Erythema sometimes occurs in the initial stage of variola, when, on account of the grave general symptoms, it may be mistaken for scarlatina. I have more than once known this mistake to be made in the hurried visit of the physician. A more careful examination would prevent this error. There is little danger of confounding erythema with measles, or the various papular, vesicular, or pustular skin diseases.

Treatment.—Erythema fugax requires no special treatment, unless occasional dusting the surface with lycopodium or powdered starch. Those forms of erythema which are due to mechanical or chemical irritants soon disappear when the cause is removed. In erythema around the anus, produced by the irritation of the urinary and alvine evacuations, the diaper should be changed as soon as soiled, and if the stools be frequent and acid, the alkaline treatment proper for the diarrhœa is useful also for the erythema. In inflammation from this cause as well as in erythema intertrigo, the following prescriptions for external use will be found beneficial:

℞.—Bismuthi subnitrat. . . . . ℥j.
Glyceriti amyli . . . . . ℥j.—Misce.

℞.—Lycopodii . . . . . ℥ss.
Pulv. bismuthi subnitratis . . . . ℥iss.—Misce.

℞.—Pulv. zinc. oxid.,
Lycopodii . . . . . āā ℥j.—Misce.

To be frequently dusted upon the inflamed surface. It is better to apply vaseline first, and dust upon this.

℞.—Zinci oxid. . . . . ℥ij.
Glycerinæ . . . . . ℥ij.
Liq. plumb. subacetatis . . . . ℥iss.
Aquæ calcis . . . . . ℥vj to viij.—Misce.

In obstinate cases a weak solution of nitrate of silver, sulphate of copper, or better, as it does not stain the linen, sulphate of zinc, will frequently be followed by immediate improvement.

℞.—Zinci sulphat. . . . . gr. vj.
Glycerinæ . . . . . ℥ij.
Aq. rosæ . . . . . ℥iv.—Misce.

To be constantly applied between the folds of the skin on linen.

Potassium chlorate, internally, to correct the acidity of the transpiration from the skin in protracted and obstinate cases, and in certain instances cod-liver oil and the syrup of iodide of iron, are called for. If

the derangement of the system upon which the erythema depends appear to be of a rheumatic character, colchicum or alkalies may be required. Erythema papulatum, tuberculatum, and nodosum occur most frequently in reduced states of the system, and therefore need tonics.

Roseola.

The term roseola is applied to rose-colored spots or patches of greater or less extent, accompanied by a degree of febrile reaction, and often by redness, with little or no swelling of the faucial surface. It is attended by a sensation of warmth and slight itching. The following groups and subdivisions embrace the recognized varieties of this disease:

ROSEOLA.

Idiopathic.	*Symptomatic.*
Infantilis.	Variolosa.
Æstiva.	Vaccinia.
Autumnalis.	Miliaris.
Annulata.	Rheumatica.
Punctata.	Arthritica.
	Cholerica.
	Febris continuæ.
	Syphilitica.

The color of the eruption gradually fades from a rose-red to a duller hue, and often disappears in two or three days. In other instances the eruption lasts a week or more. Roseola may occur in any season, but it is most common, especially the idiopathic form, in the warm months. Those varieties of the idiopathic disease which are designated infantilis, æstiva, and autumnalis are the most common in early life. They are in reality identical, or nearly so, and may be described as one disease.

SYMPTOMS.—Roseola infantilis, æstiva, or autumnalis may be partial, appearing upon the arms and legs, or general. It is often preceded by febrile movement, languor, and, in those old enough to describe their sensations, pain in head, back, and limbs. There is great difference, however, in different cases as regards the severity of the prodromic symptoms. They may be absent or so slight as scarcely to be appreciable. Occasionally vomiting, diarrhœa, or other symptoms of derangement of the digestive apparatus immediately precede the eruption.

The eruption of roseola, when general, usually commences upon or about the neck and face, and in the course of twenty-four to thirty-six hours appears upon the rest of the surface. It bears considerable resemblance to that of measles. The patches are irregular in shape, a quarter to half an inch in diameter, and, though of a rose color at first, they soon present a dusky due as they begin to fade; by pressure the redness disappears. In the majority of cases the eruption has nearly faded by the fifth day. The redness of the faucial surface, together with the itching or tingling, disappears with the subsidence of the rash.

Roseola annulata is a rare disease. It commences with constitutional symptoms, which are slight or pretty severe, and which cease when the eruption appears, this occurs in the form of red circular spots,

which enlarge to the diameter of an inch or thereabout and assume the shape of rings inclosing healthy skin. The rash fades in a few days, often leaving a bruised appearance. The ordinary location of this form of erythema is upon the abdomen, and about the thighs. In roseola punctata the eruption is of small size, and it occurs upon a large part of the surface.

Symptomatic roseola, which appears in the course of various diseases, need only be alluded to. The diseases in which it is developed are, with the exception of syphilis, chiefly of an acute febrile or inflammatory character. This eruption is often really, as stated by Tilbury Fox, a rose-colored erythema, but in other instances it presents the typical form and appearance of roseola. Thus I have known it to occur about the eighth or ninth day of vaccinia in rose-colored spots over the whole surface, and producing much anxiety on the part of parents, lest impure virus had been employed.

Causes.—These are in a measure obscure. The delicacy of the skin in infancy and the active cutaneous circulation no doubt predispose to reseola and erythema, and hence the frequency of their occurrence in acute febrile and inflammatory affections. Summer weather, with the derangements of system which it produces, has been in my experience much the most frequent cause of idiopathic roseola in young children in this city. In certain summers, as in that of 1868, a large proportion of the infants have been affected by it, and I have been led to consider it a favorable prognostic sign as regards the diarrhœal affections which are so common in the warm months.

Prognosis.—Roseola is always a mild and favorable disease.

Diagnosis.—Roseola is distinguished from measles, by the absence of catarrhal symptoms, a less degree of fever, less uniformity in the size of the eruption, and the absence of any history of contagion. Roseola is distinguished from erythema by the smaller size of the eruption and its rosy or dusky red color. The boundary line, however, between the two diseases is not well defined, and certain forms of roseola may be described as erythema. The general but punctiform efflorescence, increase of temperature, acceleration of pulse, and the peculiar appearance of the tongue and fauces, serve to distinguish scarlet fever from roseola. There is little danger of confounding roseola with urticaria, since the wheals of the latter appear in no other disease.

Treatment.—This is simple. If roseola occur in connection with gastro-intestinal derangement or disease, the remedies which relieve the latter exert a curative effect upon the former. In all cases the state of the system should be inquired into, and any departure from a state of health corrected. Roseola needs no further constitutional treatment. If there be itching or tingling of the surface, a lukewarm lotion, containing equal parts of liq. ammon. acetat. and mistura camphoræ, has been recommended, or a lotion containing a drachm of hydrocyanic acid to a pint of an emulsion of bitter almonds, used warm. The purpose of such lotions is simply to relieve the unpleasant sensation. Cold applications, or others which would repel the eruption, should be avoided; such an effect might be injurious. In case of acidity of stomach alkaline remedies are useful, and in certain cases tonic treatment is indicated.

Urticaria.

The name by which this disease is designated is derived from the term *urtica*, the nettle, the sting of which produces this form of eruption. The eruption occurs suddenly in wheals or pomphi, attended by tingling and burning, and suddenly disappearing. Urticaria is often accompanied by no very decided general symptoms, but in other cases there are febrile movement, and lassitude, with perhaps epigastric pain and headache. The wheals may occur over the whole body, but more frequently are confined to a portion of it. Their shape may be round, oval, irregular, or band-like, and their length varies from a few lines to several inches. In one affected by urticaria the wheals can be readily produced by scratching or rubbing the surface. The eruption is thus clearly described by a recent writer: "At first a bright flush appears, the centre of this becomes slightly elevated, and pales, hence appears of lighter color; the tint may be rosy, but more generally it is whitish." The margin of the wheal, the diameter of which varies, always remains red. This eruption appears to be produced by active congestion of the cutaneous capillaries, some serous effusion, and spasm of the muscular fibres of the skin. The effusion of serum in certain localities is quite apparent from the œdema which occurs. The subsidence of the eruption is without desquamation. Urticaria is ordinarily an acute disease. It is sometimes chronic in the adult, but rarely so in children. Several varieties of it are described by dermatologists, according to the cause, appearance, and duration.

Causes.—These are external and internal. Various irritants apart from the nettle applied to the surface produce the wheals, as the bites of certain insects and sometimes turpentine. The following are the principal internal causes, as summarized by Hillier: 1st, profound and sudden mental emotion; 2d, certain articles of diet, as shell-fish, pork, sausage, cheese, etc.; 3d, certain medicinal substances, as copaiba, valerian, and turpentine; 4th, intestinal worms, though it is probable that these seldom operate as a cause; 5th, uterine ailments, as hysteria.

Prognosis—Diagnosis.—The prognosis is good, though the chronic form is sometimes tedious and troublesome. The occurrence of the wheals and the possibility of producing them by friction serve to distinguish this disease from all others.

Treatment.—In urticaria due to recent ingesta of an irritating or indigestible character, an emetic of ipecacuanha is useful, followed by a saline, and better also alkaline aperient, as Rochelle salts. An aperient of this kind is useful ordinarily in acute cases, attended by febrile reaction. The diet for several days should be simple, and such as is readily digested, as fresh beef, bread, or other farinaceous food, and milk. Occasionally the wheals appear periodically, when a few doses of quinine effect a prompt cure. After the above measures have been employed, the subsequent treatment, whether tonic or otherwise, depends on the condition of the patient. Little benefit accrues from local measures. Sponging the surface with cool water to which a little vinegar is added relieves, in a measure, the heat and tingling of the wheals.

CHAPTER II.

PAPULAR DISEASES.

Strophulus.

THE three papulæ, namely, lichen, prurigo, and strophulus, which are characterized by small and firm elevations upon the skin, occur in children; but the two former are not common, and, as they do not differ in any essential particular from the same diseases in the adult, they will not be treated of in this connection. Strophulus, on the other hand, is a disease peculiar to children. It is known as the red gum or white gum, according to its appearance, and also as the tooth rash. This eruption appears usually on parts which are exposed, as the face, neck, and extremities, the papules being in some patients of the size of, or even smaller than, a pin's head, while in other cases they are as large as a millet-seed.

The varieties of strophulus described by dermatologists are:

S. intertinctus.	S. candidus.
" confertus.	" volaticus.
" albidus.	" pruriginosus.

The following are the characters of these varieties: S. intertinctus, papules bright red, and occurring chiefly upon the cheeks, forearm, and back of hand; often *intertinctured* with blushes of erythema; it lasts from two to four weeks, and is most common in young infants. S. confertus, papules numerous, and closely aggregated, paler, continuing longer than in strophulus intertinctus, and likely to recur, appearing about the time of dentition, and most frequently upon the arm. Sometimes certain of the patches become chronic, slowly disappearing, and leaving the skin rough and dry. S. volaticus appears usually upon the arms and cheeks in patches of about a dozen, fewer or more, papules, which soon disappear. These patches reappear at intervals for two or three weeks, and are attended by heat and itching, though not intense. S. albidus, so called, should really be placed among the diseases of the sebaceous glands, and described under another name. It appears in the form of small white elevations as large as a pin's head, commonly upon the face and neck, and produced by distention of the sebaceous glands with the secreted product. The term strophulus candidus is applied to large whitish papules, which appear upon the sides of the trunk, shoulders, and arms of infants of one year or thereabouts, and disappear in about one week. They are liable to be associated with the papules of strophulus confertus. S. pruriginosus is really a form of lichen, occurring chiefly above the age of one, and under that of eight or nine years. The papules, which are small and discrete, usually appear over a large

extent of surface, ordinarily upon the back, front of the chest, the face and arms, and, as they are scratched from the itching, minute dark points of blood collect and dry upon their apices. This form of strophulus is more protracted than the others, and, in consequence of the irritation produced by the scratching, pustules of ecthyma often occur among the papules. The apparent cause of strophulus pruriginosus is a mode of life which impoverishes and vitiates the blood, such as uncleanliness, and residence in damp, dark, overheated, and overcrowded apartments. Atmospheric heat also operates as a cause of this form of strophulus, and it is not an infrequent disease in cities during summer months.

The various eruptions included under the term strophulus have such different anatomical characters, that a proper classification would locate some of them in other groups of skin diseases. One form of it, as we have seen, is produced by distention of the sebaceous glands; in other, and the majority of cases, as appears from the recent observations of Mr. Fox, its seat is the sweat glands, and in others still the papillary layer of the skin, as in lichen, the papules being produced by an exudation.

TREATMENT.—Personal cleanliness, with frequent change of linen, and daily ablution without the use of soap, should be enjoined. Local irritants, which might aggravate or cause the disease, should, so far as practicable, be removed. Alkalies in cases of acidity of the *primæ viæ*, and occasionally mild aperients, are required: the food should be bland, but nutritious, and if the child be nursing, it may be necessary to attend to the healh of the wet-nurse. Favorable hygienic conditions, important for the successful treatment of all forms of strophulus, are especially required in strophulus pruriginosus. Nutritious diet, fresh air, quinine, iron, cod-liver oil, etc., should be prescribed for those affected by it. The following formula is recommended for sponging the surface in cases of strophulus:

℞ —Sodii carbonat. . . . . ℈j.
Glycerinæ . . . . . ℥ij.
Aq. rosæ . . . . . ℥vj.—Misce

CHAPTER III.

ECZEMA.

THIS is one of the most common maladies of the skin. It constituted one-third of Devergie's cases, and one-sixth of Hillier's. In the commencement of the eczematous eruption the skin presents a superficial redness, and upon this inflamed area numerous minute and closely aggregated papules, vesicles, or, more rarely, pustules, appear. These are very fragile, so that they soon rupture, the epidermis is broken and

destroyed, and the surface is moistened by an effusion which appears to be serum, and cannot be distinguished from it by the microscope. This liquid when dry stiffens linen. As it dries thin crusts form, of a light yellow color upon most parts of the surface, but they are thicker, and of a deeper yellow color, upon the scalp than elsewhere. The crusts consist mainly of pus, epithelial cells, and granular matter.

Anatomy.—Biesiadecki has described the formation of the eczematous eruption. According to him, the papules are produced from the papillæ, which increase in size by cell formation in their interior. The connective-tissue corpuscles enlarge, and are unusually "rich in fluid," and their number increases. Under the microscope spindle-shaped corpuscles are observed, filling the papillæ, and extending up from them into the rete Malpighii, crowding apart the cells of this layer, and reaching and elevating the epidermis. The epithelial cells in the immediate vicinity of the papillæ also become swollen. This cell-growth produces the eczematous papule.

If the cell formation continues within a papilla, certain of the cells are ruptured, and as they are very moist a liquid is effused, which raises the epidermis over the summit of the papilla. This produces the eczematous vesicle. Occasionally pus mixes with this liquid, and the eruption is then vesico-pustular.

In acute eczema the upper part of the true skin is infiltrated and swollen, while the lower part is commonly unaffected, except in the most severe cases. The older the eczema the greater the extent of the infiltration, so that in chronic eczema the whole thickness of the skin is more likely to be involved than in acute forms of the malady. The discharge of the eczematous surface is irritating, and healthy skin, with which it may come in contact, is often reddened by it and made eczematous, from its irritating effect. This eczema occurring upon a part of the surface which is in contact with an opposite surface of sound skin, commonly affects the latter, and, as Neumann has stated, a nurse, by carrying an infant having eczema upon its nates, may contract the same disease upon her arm, although there is no contagious principle in this malady.

Etiology.—Eczema is often produced by irritating substances applied to the skin. Croton oil, certain soaps, the finger-nails in scratching, a hat, truss, or belt, by pressure may produce it. Those having a tender and delicate skin are more liable to it than others. The constitutional causes are often obscure. It is sometimes obviously due to indigestion, or a diet which disagrees, for we see it occur in nursing infants as a result of sickness of the mother. Anæmia and scrofula are occasional causes. Among the city poor eczema is common, and many of the children who have it are scrofulous, but a large proportion show no evidence of struma, and in the better classes of society a majority do not.

Varieties—Symptoms—Course.—Eczema is sometimes designated according to its location as *E faciei*, *capitis*, etc. Another designation, which has more scientific value, is according to the form and stage of the eruption, by which we have the following recognized varieties, to wit: Eczema papulosum, vesiculosum, pustulosum, rubrum, impetigi-

nosum, and squamosum. A simpler and still more convenient classification is into eczema simplex, rubrum, impetiginosum, and squamosum.

Eczma of the scalp is common in infancy, occurring as an eczema rubrum or impetiginosum. The eczematous exudation mingling with the secretion of the sebaceous glands, which are numerous upon the scalp, forms a thick yellow crust. It is likely to extend beyond the hairy portion to the forehead and around the ears. This extension aids in establishing the diagnosis between eczema and certain other cutaneous eruptions of the scalp. Eczema of the external ear is sometimes primary, but in other instances it is consecutive to that of the scalp, and due to extension of the latter. Its common seat is in the angle behind the ear, and upon the lobe of the ear, whence it often extends along the auditory meatus, narrowing its calibre, and impairing the hearing temporarily, or even for years. Eczema upon the forehead commonly occurs in children from extension of the eruption from the scalp. The cheeks, lips, and chin are often also affected by eczema, which in this situation is commonly eczema rubrum, and is attended by redness, swelling, and troublesome itching. The swollen and red appearance with the crusts and marks produced by scratching often greatly disfigure the countenance. In children, when eczema occurs upon other parts, it is usually associated with that of the scalp, face, or ears—that in the latter situations being the most severe and obstinate.

Eczema simplex is common in the summer months, being produced by the heat of the atmosphere, aided perhaps by other causes. The patient may appear well, or be somewhat indisposed, having febrile symptoms, and soon an erythematous patch of greater or less extent appears, upon which a cluster of the characteristic papules or vesicles soon occurs. These break, forming slight crusts, which are detached, and the eczema declines, or it may continue longer, with successive crops of the eruption.

In eczema *rubrum*, since it is a more severe form of the disease, the febrile movement and the local symptoms are greater than in the preceding variety, and the eczematous patch presents the appearance of a more intense inflammation. The papules or vesicles are often so minute as to be with difficulty recognized. They are soon broken, when they form with the secretion and exudation from the surface yellowish or brownish-yellow scabs. The discharge is more irritating, as it is more abundant than in eczema simplex, and the adjacent skin is usually more inflamed from its contact.

Eczema *impetiginodes* is common in young debilitated children, in whom, in consequence of the cachexia, inflammations, of whatever character, are liable to be suppurative. This form of eczema presents at first the symptoms and features of eczema rubrum, but the transparent liquid of the vesicles soon becomes opaque, from the generation and admixture of pus-corpuscles. The crusts, which form from the rupture and desiccation of the vesiculo-pustular eruptions, are thick and greenish-yellow, and in infants the sebaceous glands, which are involved in the inflammation, pour out an abundant secretion, increasing the thickness of the crusts. This form of eczema is most common in infancy, and its usual seat is upon the scalp.

Diagnosis.—Eczema presents in different instances so different an appearance that it is not always readily diagnosticated. It will aid in its diagnosis to recollect that it is in its nature a catarrh, affecting primarily and chiefly the upper portion of the derma and the Malpighian layer, and although it may now present a dry or scaly appearance (E. squamosum), yet its history will show that there has been a discharge or moisture. In a large proportion of cases, the physician is not able to detect papules or vesicles, since they are fragile and transient, breaking in the first thirty-six hours, and not reappearing. Still, when they are absent, we sometimes observe around the margin of the patch an appearance which indicates that they have been there. Their minuteness is occasionally such that they may escape notice, on a cursory inspection, when they are present and well defined. Acute eczema, affecting a considerable extent of surface, is often attended by febrile movement, and may be mistaken for one of the eruptive fevers, but the absence of certain distinctive appearances which characterize these fevers, and the speedy appearance of the eruption and moisture, establish the diagnosis. Eczema can be readily diagnosticated from ordinary erythema, which is a superficial inflammation without moisture. The location of erythema intertrigo serves for its diagnosis, as it is evidently produced by the attrition of opposite surfaces of the skin. Moreover, it lacks the elevated papillæ, and the discharge does not stiffen linen like that of eczema. Lichen, when acute, presents some resemblance to eczema, but it is dry and papular, the papules, though small, being detected by the finger as well as sight. The large and irregular phlyctenulæ, intense inflammation and œdema, and mode of extension of erysipelas; large, scattered, and non-inflammatory vesicles of sudamina; scattered and acuminate vesicles, without surrounding inflammation, of scabies; are so different from the eczematous eruption that the differential diagnosis from those diseases is readily made. Herpes circinatus can be distinguished from eczema by its circular shape, larger size, and greater permanence of the vesicles, and the delicate, branny scales, which consist rather of epithelial cells than the product of exudation as in eczema.

Treatment.—Eczema should be cured as speedily as possible, since there is no danger that another disease will arise from the disappearance of the eruption, while, on the other hand, the restlessness and fretfulness, which the eruption often produces, may impair the general health, and the lymphatic glands receiving lymph from the eczematous patches may undergo hyperplasia and cheesy degeneration. Many cases can be cured by strictly local measures, while in others, as when there is a markedly strumous cachexia or other manifest aberration from the healthy standard, constitutional measures are important.

Constitutional Treatment.—No one line of treatment is suitable for every patient. Among the city poor strumous cases are common, and cases also in which, without any pronounced diathetic state, the cause is apparently a reduced state of the system from innutritious diet and other antihygienic conditions. Such cases require better diet, and a mode of life more in accordance with sanitary requirements. On the other hand, I have observed cases of eczema which seemed to be produced or rendered more intractable by a plethoric state of the system, especially

in the nursing infant, when the milk of the mother or wetnurse was unusually rich or abundant. While, therefore, ill-nourished and weakly children require better regimen, with perhaps vegetable and ferruginous tonics, the plethoric require reducing treatment, though of a gentle kind. Their food should be plain and unstimulating. Indigestible articles, as pastries, cheese, and rich sauces, should be avoided, especially when symptoms of indigestion are present. Indigestion or other aberration of the system from the healthy standard, should be promptly corrected. Saline aperients are useful in cases of constipation and of a plethoric habit. The saline diuretics, as the acetate and citrate of potassium, are often beneficial in acute eczema with febrile symptoms, especially if the urine be rather scanty. The following formula is recommended by Dr. A. R. Robinson:

℞.—Potassi acetatis . . . . . ʒiss.
Spts. ætheris nitrosi . . . . . ʒij.
Syrupi aurantii . . . . . ʒvj.
Aquæ caruî . . . . . q.s. ad. ʒiij.
One teaspoonful three times daily to a child of one year.

In acute as well as chronic eczema any departure from the healthy standard, whether in the digestive organs, the kidneys, or other part of the system, should be corrected so far as possible, since eczema is more readily cured when the functions of the internal organs are normally performed.

Chronic eczema as well as acute often requires internal remedies, although they are of less importance than external measures. In anæmic cases, iron is indicated, and arsenic, which should not be used in acute and moist eczemas, often produces a very beneficial effect, especially in dry eczemas, when accompanied by much infiltration. In many cases of chronic eczema the following prescription will be found useful:

℞.—Liq. potassæ arsenit. . . . . fʒj.
Tinc. ferri pomati. } . . . . . āā fʒv.
Tinc. rhei vini }
Aq. menth. . . . . fʒiv.—Misce.
Dose, one teaspoonful three times daily to a child of one to two years.

External Treatment. Acute Eczema.—The external treatment should be different in different cases, according to the stage of the disease and the condition of the affected surface. In acute eczema, irritating and stimulating applications are inadmissible. Even the garments worn should be as little irritating as possible upon parts covered by the dress. It is even recommended that the patient lie in bed in severe general eczema, with a light covering of bedclothes. Water is usually too irritating for eczema, so that baths and washes should be interdicted. Ordinary soap should never be employed in the acute disease, as it is too irritating. When the use of water is necessary for purposes of cleanliness, bran water, or thin flaxseed tea, or other mucilaginous infusion should be used. In *eczema intertrigo*, so common upon the groin and nates of infants, cotton batting, or the absorbent cotton of the shops, dusted with the following finely triturated powder, should be constantly

applied, so as to come thoroughly in contact with the inflamed surfaces and separate them: boracic acid one part, salicylic acid one part, subnitrate of bismuth or oxide of zinc five parts.

Pruritus.—Itching is a frequent and annoying symptom of eczema, and whatever curative applications may be made use of, something to relieve this symptom is often required. Camphor mixed with ointments or washes, relieves itching. A two per cent. solution of acetic acid, or a half to a two per cent. solution of aluminium acetate in water, also frequently gives relief. Carbolic acid is one of the most effectual agents to relieve pruritus. The following formula is essentially that recommended by Kaposi:

℞.—Acidi carbolici	grammes xv.
Spts. vini gallici	f℥ v.
Tinc. lavendul. }	
Eau de cologne }	āā f℥ vj.
Glycerini	℥j.—Misce.

Veiel says that even this small amount of glycerine is sometimes too stimulating to the surface, and, if so, it should be omitted.

Curative Applications.—In the commencement of eczema papulosum or vesiculosum, common powdered starch, talc (magnesium silicate), semen lycopodii, or rice starch (amylum oryzæ), is beneficial for dusting the part. The following formula is substantially that recommended by Kaposi:

℞.—Amyli orizæ	℥iij.
Talc venet. }	
Flor. zinci, }	āā ℥j ¼.
Pulv. irid. florent. }	
	Misce.

Camphor may be added to this to relieve itching, in the proportion of two per cent.

Curative Applications.—For healing the eczema in its acute stage, the following ointments are the most useful:

℞.—Emplas. plumbi, }	
Vaseline, }	Equal parts.

Ung. zinci benzoat, either in full strength or reduced by mixture with vaseline. In full strength it is sometimes too irritating. Crusts should be removed by soaking them with oil, or by an emollient poultice, and some hours subsequently washing the surface with warm water. If the surface be moist, the powder, prepared according to the above formula, can often be advantageously used instead of the ointment. A convenient and effectual way of using the ointment is to spread it thickly on linen or lint, which is then bound down by gauze. In eczema facei, a mask may be made with openings for the nose, eyes, mouth, and ears, and bound down upon the surface. In that form of eczema in which the skin is red and desquamating, the milder ointments should be used, rubbed in three times daily.

Chronic Eczema.—The crusts should be removed by strips of linen or gauze soaked with cold distilled water, and frequently applied, so that the water does not become warm, for warm water applications by their irritating action may produce eczema. An equal quantity of Goulard's

extract may be added to the water if the skin is irritable (Veiel). Oils are, however, in most instances, preferable to water for the removal of crusts. Cod-liver oil, mutton suet, or one of the mild ointments, as cold cream, should be thoroughly applied by a painter's stiff brush upon parts covered by hair, so as to break through the crusts. On smooth surfaces, an ointment, as simple cerate, should be thickly spread on surgeon's lint or flannel, and applied over the crusts, which will usually come away on the removal of the plaster. A mild soap, the alkali of which dissolves the epidermis, will remove those crusts which the above measures fail to clean off, as Sarg's liquid glycerine soap. Lately salicylic acid has come into use as a solvent of crusts. The following ointment rubbed in hourly, or applied thickly spread on surgeon's lint, in a few days renders the surface clean:

℞.—Acidi salicylic. . . . . ʒj.
Vaseline . . . . . ʒiss.—Misce.

The first indication has now been accomplished, that of denuding the surface of crusts. The next indication is to cure the disease. In order to heal the moist surface the best application in most cases is still the diachylon ointment, the emplastrum plumbi recommended above, or the zinc ointment, by which the moist eczema becomes squamous. If the surface is slow in healing, Sarg's liquid glycerine soap or the following:

℞.—Saponis viridis . . . . . 200.
Spirit. rectific. . . . . 100.
Digestre filtre;

should be poured upon moist flannel rubbed in, and then removed with tepid water. After drying the parts the ointment should be reapplied. Occasionally, on parts to which the lead or zinc ointment cannot be conveniently applied, as upon the face, one part of tannin to ten or fifteen of vaseline or cold cream may be used instead.

By the above treatment the moist surface usually becomes squamous. The eczematous patch is still hyperæmic, infiltrated, and desquamating, and additional measures are required to restore it to the normal state. Moderately stimulating applications are now required, and tar is the best agent for this purpose. Tar should never be applied in moist eczema. Its use should be reserved for the dry and desquamating eczema.

The various tars, which have been used with success in eczema, are the pix liquida or pine-tar, the oleum fugi or beech-tar, the oleum rusci or birch-tar, and the oleum cadinum obtained from the juniperis oxycedrus. Tar penetrates all the layers of the skin, for when used externally it has been found in the urine. In a few patients it is stated that its employment has been followed by rigors, fever, headache, and vomiting. If such symptoms arise, its use should of course be discontinued. The following formulæ may be employed:

℞.—Ung. picis liquidæ . . . . . ʒj.
Alcoholis . . . . . ʒij.—Misce.

℞.—Olei rusci vel. cadini . . . . . fʒj.
Alcoholis . . . . . fʒij–iij.—Misce.

Use externally.

℞.—Olei rusci vel. cadini . . . . . f℥j.
Alcoholis } . . . . . āā f℥iss.—Misce.
Etheris }

Use externally.

Tar is useful when the skin chaps, or is rough. In cases that are in a state of transition from the acute and moist to the chronic and squamous form of the disease, the mixture of the tar ointment with the diachylon ointment often has a salutary effect.

Scabies.

The diseases of the skin previously considered are non-contagious. Scabies, on the other hand, is one of the most contagious diseases by contact. It is produced by an animal parasite, known as the itch-mite, or *acarus scabiei*. The inflammation is caused by the female only, which burrows, making for itself a canal, or cuniculus, in which its eggs are deposited. The male does not burrow, but conceals itself under the scales or crusts which result from the inflammation produced by its partner, or it burrows only sufficiently to produce a covering and shelter. From observations made by Eichstedt, Gudden, and others, the female has been found within half an hour after being placed upon the skin to

FIG 37. FIG. 38. FIG. 39.

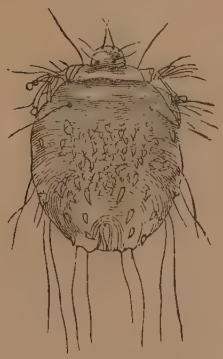


FIG. 40.

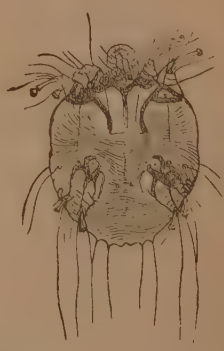


FIG. 37. The itch animalcule, acarus scabiei, viewed upon the back, showing its figure and the arrangement of its spines and filaments. The female, which is somewhat larger than the male, has a length of 1-80th to 1-60th of an inch.

FIG. 38. The foot and last joints of the leg of the itch animalcule

FIG. 39 The male itch animalcule, viewed upon the under surface, showing its legs and lobulated feet.

FIG. 40. Ova of the itch animalcule.

have concealed herself in the epidermis, and the burrow which she constructs is arched and tortuous, and four or five lines in length, shorter or longer. The acarus has the shape of a tortoise. It can, when fully grown, be detected by the eye as a minute whitish point. The young acarus has six, the mature eight, articulated legs, with suckers upon the two anterior pairs, and hairs on the posterior. The head, which can be elongated or retracted, is provided with two jaws. The upper surface

is covered with spines directed backward so as to prevent retrogression in the burrow. She leaves behind her in the cuniculus, as she advances, her moulted skin, excreta, and eggs, which hatch on the eleventh day. The mother acarus is always found at the remote end of the burrow, where it can be seen by the unassisted eye as a minute whitish or sometimes brownish speck, and from which it can be lifted by the point of a needle, to which it clings. The cuniculi can also be seen by the naked eye, looking, says Niemeyer, like the "scars of needle scratches," and containing the young acari in various stages of growth.

The acarus by its burrowing produces an irritation and troublesome itching, which is the chief cause of the suffering of the patient. At the point where the acarus penetrates the cuticle the inflammation gives rise to a single, small, and acuminate vesicular or papular eruption, the cuniculus extending away from it. We often find ecthymatous pustules and abrasions intermingled with the vesicles, the result of frequent scratching. The itching is most intense, and the acarus most active, at night, when the patient is warm in bed. Scabies most frequently appears, especially in adults, first upon the hands, between the fingers, where the skin is thin, and it extends thence along the forearm, and over the thighs and abdomen. In children it not infrequently occurs upon the buttocks, thighs, feet, etc., while the hands and forearm escape.

Diagnosis.—Correct diagnosis is important, because the treatment required is different from that in any other exanthem, and because the suspicion of having this disease always renders one solicitous to know the exact nature of the eruption. Scabies can be diagnosticated from those diseases for which it may be mistaken by the following characters: its occurrence where the cuticle is thin and delicate, as between the fingers, along the anterior aspect of the forearm, upon the abdomen, thighs, and inside of the feet; small size, acuminate shape, and isolated position of vesicles; the intermingling with the vesicles of other forms of eruption, as papules and pustules, and the presence of linear scars and abrasions produced by the scratching; itching most intense at night; absence of fever; absence of the disease from posterior aspect of body and arms, and from head and face. Scabies may be distinguished by the vesicular character of the eruption from all other exanthematic affections except eczema, sudamina, and herpes. Eczema is most common on the scalp and face, where scabies does not occur, and unlike scabies its vesicles are round and thickly aggregated in clusters; in eczema there is a smarting or prickling sensation very different from the intense itching of scabies. In herpes the vesicles are large, rounded, and in clusters, and attended by a burning or pricking sensation, with but little itching. This eruption in sudamina is vesicular and discrete, as in scabies, but it is globular, and accompanied by no itching or other local symptoms.

Treatment.—As scabies is due to a species of acarus which burrows in the epidermis, it can only be treated successfully by measures which destroy this animalcule. If it be destroyed, the disease gets well of itself. Sulphur has been employed for a long period for this purpose, since sulphurous acid, which is evolved from the sulphur, is destructive

to the animalcule. The unguentum sulphuris, if thoroughly applied, will rarely fail to eradicate scabies. The internal use of sulphur aids the external treatment, since a portion of the gas which is generated escapes through the pores of the skin. The chief objection to the employment of sulphur is its exceedingly unpleasant odor, which is noticeable, however disguised by perfume. Sulphur or any other substance employed externally has more effect if it be preceded by a bath, which softens the epidermis, and therefore favors the entrance of the remedy into the pores of the skin and the cuniculi.

Helmerich's ointment is very effectual in the treatment of scabies. It consists of two parts of sulphur, one of carbonate of potassium, and eight of lard. "M. Hardy afterward perfected the method, so as radically to cure the disease in two hours. He proceeded in the following manner: The patient first undergoes a friction of his whole body for half an hour with soft soap, in order to cleanse the skin and break up the burrows; a warm bath of an hour's duration follows, during which the skin is thoroughly rubbed, in order to complete the destruction of the burrows; after which frictions for half an hour and upon the whole surface are practised with Helmerich's ointment. This completes the cure. Out of four hundred patients subjected to this treatment, only four returned to the hospital."[1]

M. Albin Gras experimented with different substances, in order to ascertain their relative destructiveness to the acarus. The following table gives some of the results of his experiments:

Immersed in	pure water	the acarus was alive after three hours.
"	saline water	the acarus moved freely after three hours.
"	Goulard's solution	the acarus lived after one hour.
"	olive, almond, or castor oil	the acarus lived more than two hours.
"	lime-water	the acarus died in three-fourths of an hour.
"	vinegar	" " twenty minutes.
"	alcohol	" " " "
"	turpentine	" " nine "
"	iodide of potassium	the acarus died in four to six minutes.

It is seen that vinegar, lime-water, alcohol, turpentine, and iodide of potassium destroy the acarus in a short time. They may be employed in the same manner as the sulphur ointment. Camphor is also destructive to this animalcule, and the linimentum camphoræ, thoroughly applied, is a good remedy for uncomplicated scabies.

In order to avoid the odor of sulphur, which is so offensive, one of the following ointments may be employed, if the patient be fastidious:

℞.—Unguent. hydrarg. ammoniat. . . . . ℥j.
Moschi . . . . . gr. ij.
Ol. lavendul. . . . . gtt. ij.
Ol. amygdal. . . . . ℥j.—Misce.[2]

If scabies be extensive this should not be used, as its application over considerable area might endanger salivation, but the following, which is

[1] Stillé's Therapeutics, etc., vol. ii. p. 516. [2] From Wilson.

recommended by Bazin, and is said to cure the disease with three applications, may be used instead:

℞.—Anthemis pulv
Adipis,
Ol. olivæ, } . . . . . āā ℥j.—Misce.

In cases which have been protracted, and in which ecthymatous and other secondary eruptions have occurred, the scabies can ordinarily be readily cured, while the other eruptions remain and disappear more slowly. A knowledge of this is important, since the sulphur or other ointment employed for the cure of scabies, should be discontinued when the itching ceases and vesicles no longer appear, and tonic or other treatment appropriate to cure these secondary eruptions, should be employed instead. The sulphur ointment continued after the scabies is cured does harm, as it irritates the cuticle. It is essential in the treatment of scabies that the linen be frequently changed.

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